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The cars built by the Wagner Palace Car Co. for the "Exposition Flyer," or 20-hour train, between New York and Chicago (New York Central & Hudson River R. R. and Lake Shore & Michigan Southern Ry.), weigh 80,000 lbs. each. The weight of the train is, therefore, 320,000 lbs. (160 net tons), or 400,000 lbs. (200 net tons) with the dining car attached, the dining car not being run through. The engines used are all of the eight-wheel type. Those on the New York Central are similar to that illustrated in our issue of May 18, and those on the Lake Shore & Michigan Southern Ry. we shall illustrate next week. All of the cars are fitted with folding steps (folding up so as to close the lower part of the vestibule door opening) and the Leonard hydraulic buffers. Mr. J. C. Yager, General Superintendent of the Wagner Palace Car Co., informs us that these buffers are not yet used on any other cars, but will probably be fitted to others later. The entire equipment for this fast train service was specially built for the purpose. The company exhibits five cars at the World's Columbian Exposition: a compartment car, sleeping car, drawing-room car, dining car, and buffet smoking car. The Wagner cars have been illustrated and described in our issues of June 16 and Aug. 4, 1892.

An outline of the sewerage system at New Orleans, proposed by the New Orleans Sewerage Co., indicates that all the sewage of the city will be conveyed to a pumping station, with a daily capacity of 18,000,000 gallons, from which there will be a 30-in. iron outfall discharging into the river 30 ft. below low-water mark. At the outlet there is said to be a sharp curve and rapid current. The size of the sewers will range from 8 ins., round, to 5½×8 ft., egg-shaped, the latter at the pumping station, where it terminates 24 ft. below the ground surface. Provision will be made for flushing the sewers from a water main drawing its supply from the river, and also from flush-tanks. Mr. Geo. M. Earle is chief engineer of the company, and Mr. B. M. Harrod, local consulting engineer. Mr. H. C. Lowery, formerly city engineer of Denver, is also consulting engineer to the company.

The Minnesota Canal Co., whose project was noticed in our issue of May 25, has met with a setback in its attempt to secure a subsidy from the city of Duluth. The company asked the county of St. Louis, in which Duluth is located, to bond itself for $600,000 in aid of the enterprise. The Duluth Chamber of Commerce and the principal city officials strongly opposed the proposition, holding that the terms of the contract did not sufficiently protect the city. A special election was held on May 31 to vote on the question whether the bonds should be issued, and the bond proposition was defeated by a vote in the city of Duluth of 2,170 to 63.

The most serious railway accident of the week was a head collision, June 5, at Cortland, N. Y., on the Delaware, Lackawanna & Western R. R. A light engine standing in the yard, with no one on it, started off and ran onto the main track, colliding with a southbound express train on an iron bridge about ¾ mile north of the station. The light engine was wrecked and the engine of the express was derailed and ditched, the engineman and fireman being killed. The man in charge of the light engine stated that he was in the shed at the time, and tried to reach the engine when it started, but was not in time.

A fall of earth in the Busk tunnel on the Colorado Midland R. R., on June 1, buried six men, three of whom were killed.

The gates of Lock 19 on the Cornwall Canal, at Cornwall, Ont., were knocked down by a canal boat June 2.

A locomotive boiler explosion occurred May 30 on the Cranberry Lumber Co.'s road near Duluth, Minn. Two men were injured. A similar accident occurred June 3 on the Norfolk & Western R. R. near Waverly, Va., injuring two men. The engine was hauling a freight train at the time.

A grade-crossing accident occurred at Chicago, Ill., June 2. A street car was crossing the Chicago, Rock Island & Pacific R. R. at 60th St. when it was struck by the engine of a work train, running tender first. One person was killed and three were injured. The gate had been raised after the passage of a southbound train, and the conductor of the street car, who was standing by the track, signaled the car driver to cross. The gateman and conductor both claim that they did not see the work train on account of the smoke.

A wooden railway bridge at May's Landing, N. J., was burned June 6, having been set on fire by coals dropped from a freight engine.

An accident, resulting in the loss of two lives, which occurred May 8 at Cuyahoga Falls, O., is of special interest to bridge builders and public officials. A highway bridge across a deep chasm had been torn away to give place to a new structure, and that night a young man and woman, who were out driving, and ignorant of the state of affairs, attempted to cross the bridge. There was neither watchmen nor warning lights, and the barriers were too slight to arrest their course or prevent them from being hurled over the high cliffs, to meet instant death in the river below, from the waters of which, miles below, one of the bodies has lately been recovered. The horse escaped serious injury, and was found about 20 ft. from the top, supported in part by a shelving rock, and in part by the entanglement of the harness in the framework of the bridge. The fate of the victims was strennously denied by many until the body of one was found in the river.

The bridge built across the Susquehanna River, at Harrisburg, Pa., by Theodore Burr, in 1816, was nearly destroyed by fire on May 22. This wooden, arched structure is said to have originally cost $200,000 and a part of it was swept away by a flood in 1846, and in 1864 the span between Harrisburg and the island was entirely burned.

Under the new rules for the reorganization of the engineering department of the Chicago drainage canal, reported by the Board, but not yet adopted, the salaries paid would be as follows: Chief engineer, $7,200 per annum; one first assistant chief engineer, $3,600; second assistant chief engineer, $2,700; a superintendent of construction, who must be a competent engineer, $5,400; seven assistant engineers at $2,400 each; sub-assistant engineers at $125 to $150 per month, and one record clerk at $1,500 per year.

A coast or hydrographic survey of the shores of Canada is urged by Dr. Johnson, of McGill College. There is no official body corresponding to our Coast and Geodetic Survey in Canada, and the topography of the coast, with its rocks, reefs and shoals, has never been completely determined; though fragmentary work has been done and is being done under the Minister of Marine. The British Admiralty has, it is true, prepared many charts of this coast, and Dr. Johnson thinks that the Canadian organization proposed should work in conjunction with the Admiralty and share the expenses of a complete survey with Great Britain.

Railway and overhead highway bridges are to be raised by a law passed by the last New Hampshire Legislature, and the state board of railway commissioners is now hearing the chief engineers of the various lines on this subject. Under the law the commission can compel this raising of bridges under a penalty of $50 per day for non-compliance. The expense of the improvement is to be paid by the railway company; though the cost outside the railway property may be recovered as an ordinary debt from the town or city, if the commission so decides on petition. No covered bridge shall hereafter be constructed in the state with less than 21 ft. between the top of rail and lowest point of the overhead structure, except under special written permission of the commission. No railway company shall hereafter receive or haul any freight car exceeding 14 ft. in height from top of rail to top of running-board.

The Krag-Jorgensen magazine rifle is to be the standard for the United States army, according to the decision of the Board of Ordinance and Fortification. This decision declares in effect that American inventors cannot yet design a rifle superior in all essential features to this foreign arm, though the board gave a second chance to Americans, at Springfield, after their first announcement of the merits of the Krag-Jorgensen gun. As soon as the Secretary of War approves the finding of the Board it is expected that the manufacture of these rifles will begin, under the act of Feb. 27, 1893, appropriating $400,000 for this purpose.

Irrigation contracts, in eastern Oregon and Washington, are now under way to the amount of $3,160,000, says the Tacoma "Ledger." On these projects the sum of $1,245,000 has already been expended, and 283,000 acres are irrigated out of about 1,000,000 acres, which will be covered by the completed canals.

The Central & South American Telegraph Co.'s cables aggregate 9,020 miles in length, and these are supplemented by 1,800 miles of land lines. Galveston, Tex., is the great distributing point in the north. From there one cable goes to Tampico, and another to Vera Cruz, with a land line across to Salina Cruz on the Pacific side. From the latter point one cable ends at Libertad, and another reaches San Juan del Sur, in Nicaragua; from San Juan one cable loops in to Panama and other points along the coast down to Lima, and another cable stretches straight for San Elena, for Lima and Iquique, and ends at Valparaiso. At the latter point an overland line connects with Montevideo, and a cable again connects the latter place with Rio Janeiro. Messages are transmitted via Galveston from Buenos Ayres and London within one hour, and between the City of Mexico and London frequently within 15 minutes.

Water-pipe for a 30-in. main, to be laid between Jersulem and Joppa is being bid for, with a prospect of success, by the Radford Pipe & Foundry Works, of Anniston, Ala. The world is getting smaller, as far as supply and demand are concerned.

Brick street pavement in St. Louis is especially recommended for use on many streets and alleys of that city, in the annual report of Mr. George Burnet, late President of the Board of Public Improvement. Street Commissioner Murphy, of the same city, roundly condemned brick for paving purposes in a late communication, republished by us; but as Mr. Burnet is an engineer, while Mr. Murphy is not, the report of the former is doubtless based upon better information and knowledge of the true facts of the case.

Cut nails showed an average superiority of about 73% over wire nails in the late competitive tests at the Watertown Arsenal. As the production of steel wire nails now exceeds the output of cut-nails, and as the manufacturers of the latter nail claimed that they had more holding power in wood, a challenge was issued and accepted and the Arsenal test was to decide relative merit in this particular. In all, 1,160 nails, ranging from 1¼ in. to 6 ins. in length, were driven into spruce and pine timber, and the force required to pull them out was measured on the Emery machine. In the 58 series of tests the cut nails came out ahead in each and in most cases very much ahead. With floor nails, from 2 to 4 ins. long, driven in spruce, the resistance of the cut nails was 80% greater than that of the wire nails; with finish nails in spruce the cut nail was 72% ahead, and when driven in pine with the taper perpendicular to the grain of the wood, the excess resistance in favor of the cut nail was 135%. Even with the taper parallel to the grain of the wood the cut nail afforded a resistance 100% greater than that of the wire nail.

COST OF WATER MAIN EXTENSIONS AT DALLAS, TEX., IN 1892 AND 1893.

By Frank E. Snyder, Assistant City Engineer.

The completion of two contracts for furnishing material and laying new water mains in the city of Dallas, Tex., makes available the figures detailed in the two tables below.

Table I. includes the cost of the pipe furnished, and the cost of the work incident to laying new pipe, connecting it up, and taking up old pipe. Table II. gives the cost of transferring the service pipes from the old to the new mains.

The contract for furnishing pipe and special castings was let to the Howard-Harrison Iron Co., of Bessemer, Ala., and the contract for furnishing all other material and laying the pipe to Brown & Dabney, contractors, of this city, the city furnishing valves and hydrants.

In Table I., column giving average weights per foot of cast iron pipes is to be noticed the variation from the specified weights, the margin being slightly above the standard, the specified weights per lineal foot being as follows: 24-in., 250 lbs.; 18-in., 165 lbs., and 12-in., 80 lbs., with an allowance of 4% variation above or below. The average weights were deduced as general averages, taking the total weights received of each kind, and dividing by the number of lengths, at 12 ft. each, of that kind.

The cost of specials and valves, the resetting of pavement and rock trench on any line were rated on the total length of that line.

Hauling was done by the ton both from the cars and for the pipe taken up; the prices per ton of pipe were as follows: 24-in., 75 cts.; 18-in., 65 cts.; 12-in., 55 cts.; all sizes less than 12-in. at 50 cts.; the longest haul was but a little over a mile, and that mostly on paved streets.

New hydrants from the Eddy Valve Mfg. Co., of Troy, N. Y., with double nozzle and one steamer opening, fed by a 6-in. pipe from the main, were set in place of old hydrants with only a 4-in. connection.

The 24-in. main was laid from the pumping station alongside of an old 18-in. force main to a point where the 18-in. main made a turn eastwardly, striking the business district of the city, after which the 18-in. main was cut off at that point and the eastern part connected with the 24-in. by a Y; then the part alongside the 24-in. main taken up and extended straight ahead from the 24-in. into the business district. The 12-in. main was laid on the principal business streets from the new 18-in. to a connection with the former 18-in.; these lines also closing two other circuits of 10-in. pipe between the two 18-in. lines.

Delays were often occasioned by lack of specials, and I can advise parties undertaking the work of enlarging water service, on old lines, to be particularly careful in ordering specials to always have a plentiful supply on hand.

The service connections were quite an item, numbering 289, as shown by table, not including connections larger than 2 ins. for elevators, etc.

In order not to "lay out" the service to consumers any great length of time, on the lines of old pipe taken up, the work of transferring to the lines of 12 and 18 ins., upon which were nearly all the services, was carried on by connecting the intersecting mains between each two valves on these main lines, then turning the water in and transferring services, and taking up the old mains simultaneously in this distance, thus not blocking the street for any great length at one time. The valves on the 12 and 18-in. lines were placed from 600 to 1,000 ft. apart, depending on street intersections, and the number of interesecting mains.

Valves were set opposite the property line of an intersecting street, following a uniform custom in vogue here.

The completion of these large mains gives the 24-in. force main, feeding two 18-in. lines with circuits of 10 and 12-in. pipe in the heart of the city. The greatest consumption is now about 5,500,000 gallons per day, and the extent of the system now comprises a total of 255,170 ft., or 48.3 miles of mains, not including sizes less than 4 ins., of which there are a number of short lines. The length of the various sizes of pipe 4 ins. and more in diameter is as follows:

Size, ins.	Length, ft.	Size, ins.	Length ft.
24	3,890	10	6,790
18	7,813	8	12,626
16	5,125	6	118,380
12	6,763	4	93,843

The Holly Mfg. Co., of Lockport, N. Y., is now erecting two new pumps, which will be in use within the next few weeks. The pumping machinery will then include two Gaskill horizontal compound high service engines of 6,000,000 gallons daily capacity each, and one cross-compound low service engine of 10,000,000 gallons daily capacity; the latter and one high service engine being the ones in course of erection at the present time.

TABLE I.—Cost of Water Pipe in Place.

			Pipe and laying. Cost per lin. ft., $.								
Size, ins.	Length, ft.	Av. wt. per ft., lbs.	Pipe.	Valves and specials.	Hauling.	Trenching.	Laying.	Repaving. Rock. Rate per ft. $		Total, $. Cost, per ft.	Am't.
24	3,817	253	3.125	0.267	0.095	0.25	0.30	.....	0.023	4.06	15,497
18 (new pipe)	1,270	170	2.10	0.246	0.055	0.23	0.25	0.066	.....	2.947	3,743
18 (relaid)	3,590	....	.....	0.246	0.054	0.23	0.25	0.066	.....	0.846	3,037
12	6,763	82¼	1.016	0.15	0.022	0.20	0.15	0.144	0.033	1.715	11,599
Connections:											
10 (lowered)	70	....	.....	2.10	.....	0.15	0.14	0.15	.....	2.54	178
6 (relaid)	450	....	.....	0.65	.....	0.15	0.08	0.15	.....	1.03	463
4 "	110	....	.....	.....	.....	0.15	0.05	0.15	.....	0 35	38
Pipe taken up:			Taking up.								
18	3,720	....	0.10	.....	.....	.....	.....	.....	.....	0.20	744
6	6,870	....	0.18	.....	0.008	.....	.....	0.15	.....	0.338	2,322
4	1,760	....	0.16	.....	0.006	.....	.....	0.05	.....	0.216	380
Hydrants:			Net cost.								
24 new, set	...	....	27.50	.....	.....	.....	5.00	.....	.....	32.50	780
21 removed	....	....	.....	.....	.....	.....	10.00	.....	.....	10.00	210
Total											$38,991

Note.—Pipe, $24.70 per ton; specials, 2¼ cts. per lb. (valves separate prices). All 18-in. specials and valves rated on total length of 18-in. pipe laid. Repaving per lineal foot of trench at 15 cts. Rock per lineal foot of trench, 1 ft. deep, at 25 cts. All pipe was laid with 3 ft. of earth covering.

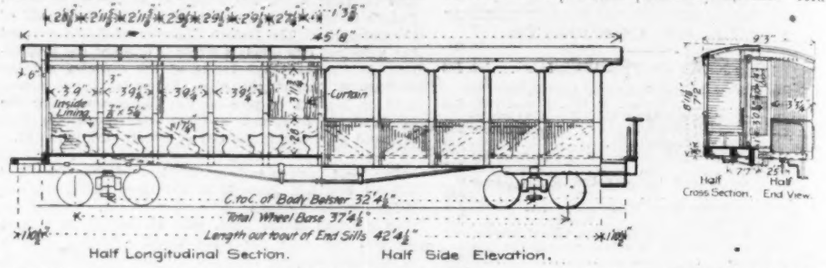
TABLE II.—Cost, in Dollars, of Service Connections Transferred from Old to New Mains.

	Lead connections. ¾-in.		¾-in.		1-in.		Galvanized iron pipe. ¾-in.		1-in.		1¼-in.		1½-in.		2-in.		
Location.	No.	Price.	No.	Price.	No.	Price.	Lin. ft.	Price.	Lin. ft.	Price.	Lin. ft.	Price.	Lin. ft.	Price.	Lin. ft.	Price.	Total cost.
On 24-in	....	....	2	2.60	..	..	16	0.37	..	....	..	....	..	....	..	....	11
On 18-in	3	2.10	30	2.60	1	2.95	260	0.37	8	0.40	..	....	..	....	..	....	187
On 12-in	200	2.10	32	2.60	21	2.95	2,820	0.37	170	0.40	60	0.47	24	0.55	97	0.60	1,776
Total																	$1,974

Note.—Corporation cocks furnished and put in place by the city. Lead connections 15 ft. long, all new, furnished by contractor. Galvanized iron pipe, all new, prices include furnishing, laying, repaving, etc., complete, by contractor.

SPECIAL CARS FOR EXPOSITION TRAFFIC.

For excursion traffic between the World's Columbian Exposition and places 20 to 30 miles distant on the lines of the Chicago & Northern Pacific R. R. and Baltimore & Ohio R. R., each of these railways has provided 50 open passenger cars of light construction, as noted in another column.



SPECIAL CAR FOR EXCURSIONS TO WORLD'S COLUMBIAN EXPOSITION; CHICAGO & NORTHERN PACIFIC R. R.

These cars were designed by Mr. Wm. McIlwain, Superintendent of Motive Power of the Chicago & Northern Pacific R. R., and were built by the Harvey Steel Car & Repair Works, of Harvey, Ill. They are of very simple construction, with transverse seats and a middle aisle, end doors and platforms. The cars are 42 ft. 4½ ins. long over end sills, 8 ft. 9 ins. wide over side sills and 12 ft. ⅞ in. high from rail to top of roof. They are carried on four-wheel trucks, with elliptical springs; the distance between truck centers is 32 ft. 4½ ins., and the total wheel base 37 ft. 4½ ins. There are 20 seats, accommodating 80 passengers, except in some of the cars which have closets, and have a seating capacity of 76 passengers only. To a height of 2 ft. 6 ins. above the floor the sides have an inside sheathing of longitudinal strips ⅞ in. × 5¼ ins., and outside sheathing of vertical strips. The open spaces between the posts may be closed by canvas curtains sliding by rings on top and bottom rods. The cars are equipped with Westinghouse brakes.

HARVEY STEEL CARS.

The progress made in the introduction of steel for car construction, and the advantages possessed by such construction, were discussed at some length in our issue of May 19, 1892 (pp. 499 and 509). The Harvey steel cars, built by the Harvey Steel Car & Repair Works, of Harvey, Ill., were described and illustrated in our issue of July 11, 1891, and since that time Mr. J. D. McIlwain, General Superintendent of the works, has made a careful study of the weak points developed in the first cars built, and has introduced many changes in the design. The cars which were originally leased by the Chicago, Milwaukee & St. Paul R. R., have been purchased by the Calumet & Blue Island R. R. They have been in constant service for the past two years, and have been in three wrecks. Mr. McIlwain states that the trucks of these cars remained intact, but that it would have cost more to repair the bodies than to have built new ones. The reason for this is that the parts were not interchangeable, and too many rivets were used. The steel I-beams, channels and other sections are of the standard sizes made by all manufacturers; the flat bars, plates and round steel are made of the Glendon steel, manufactured by Dilworth, Porter & Co., Pittsburg, Pa.

The cars now being built by the Harvey works are from designs made by Mr. McIlwain, who has now had two years' experience with this line of work, and has had the handling of the cars originally built by this company. The principal changes which he has made are in having the design conform to the M. C. B. standards of car construction, and he has aimed to minimize the number of parts and to have all parts interchangeable. Bolts are used instead of rivets wherever it is possible, and the strong point claimed for this arrangement is, that in case one of these cars gets into a wreck and gets badly bent out of shape, the builders can take any part out by removing the bolts, straighten it and put it back again.

We illustrate this week the framing for steel tank cars built at these works for the American Cotton Oil Co. The car weighs 19,900 lbs. without the tank, and has a capacity of 60,000 lbs. The

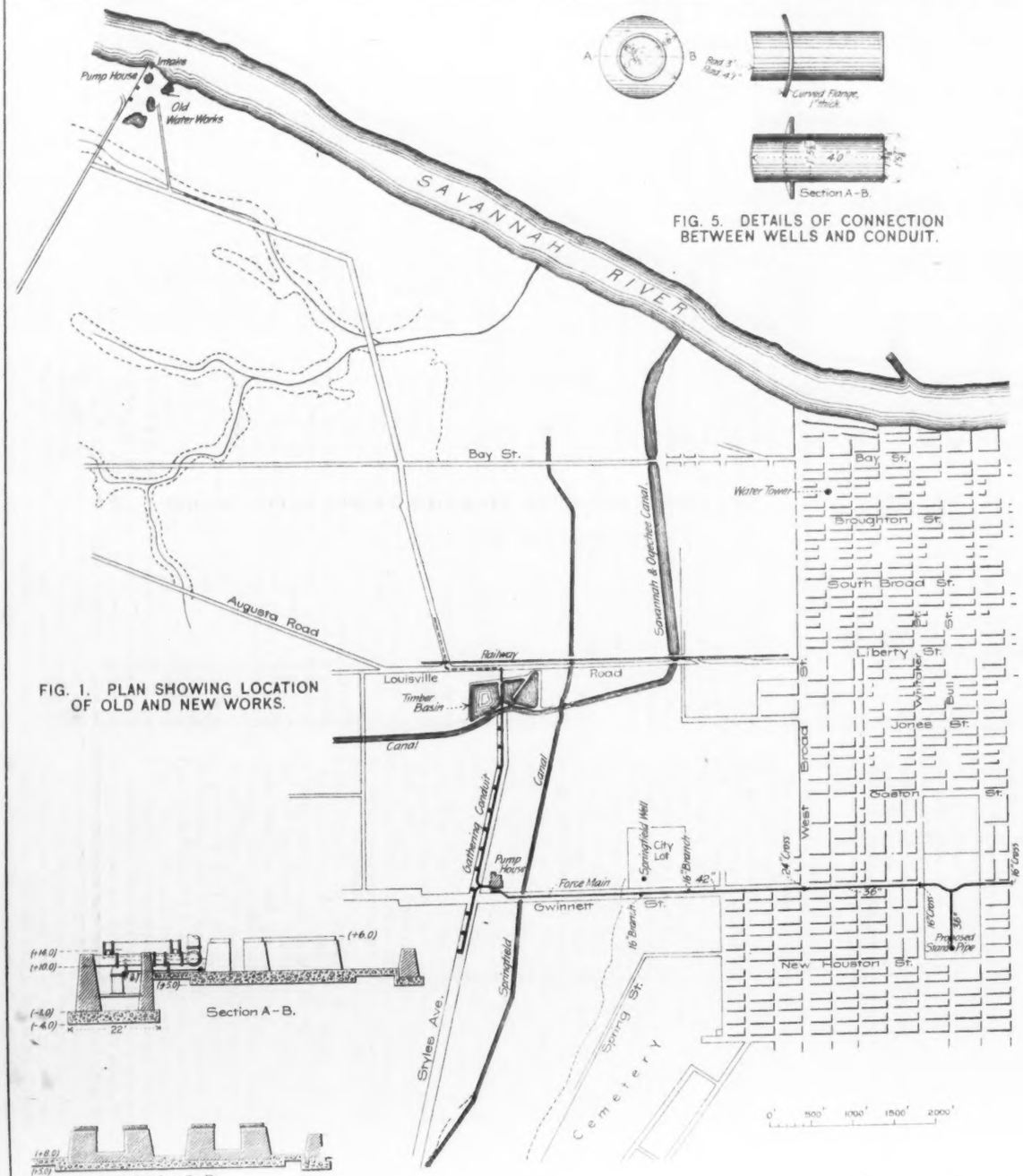


FIG. 1. PLAN SHOWING LOCATION OF OLD AND NEW WORKS.

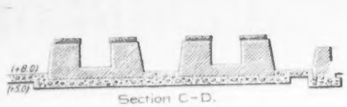
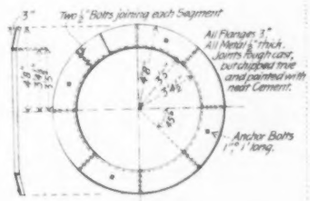
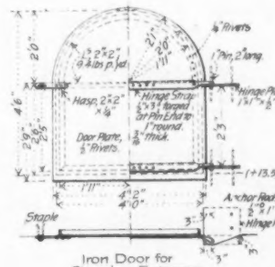


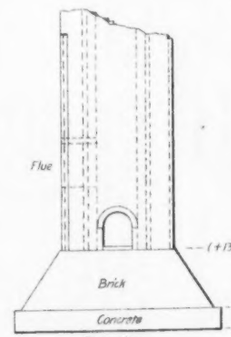
FIG. 5. DETAILS OF CONNECTION BETWEEN WELLS AND CONDUIT.

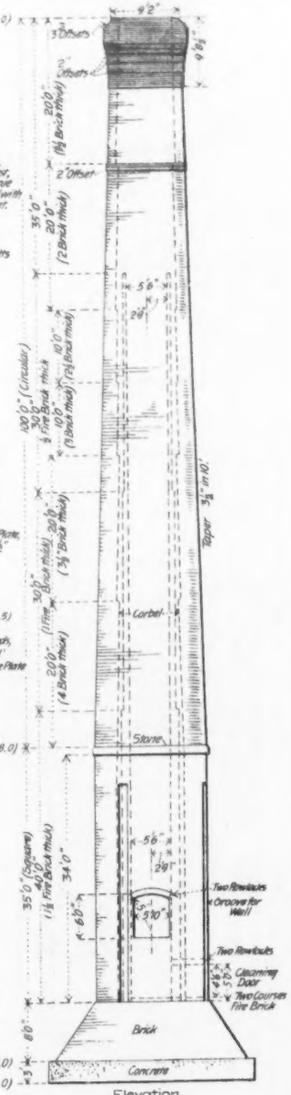

Two ¾" Bolts joining each Segment
All Flanges 3" All Metal ⅜" thick. Joints Rough cast, but chipped true and painted with neat Cement.
Anchor Bolts 1" x 1" long.

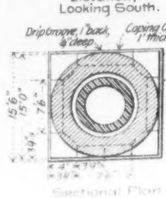
Cast Cap for Top of Chimney.



Iron Door for Cleaning Entrance.







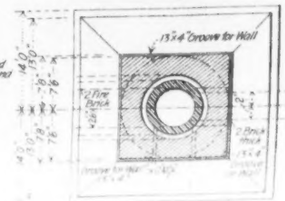


FIG. 9. DETAILS OF CHIMNEY.

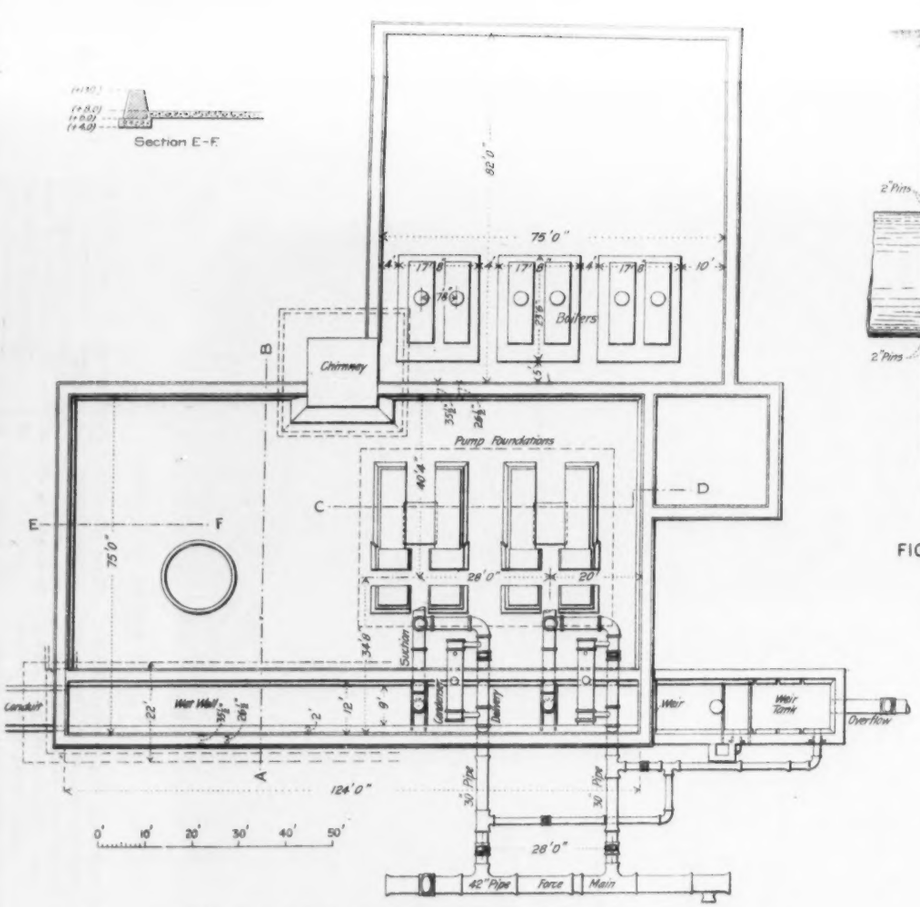


FIG. 7. GENERAL PLAN OF PUMPING STATION AND SECTIONS OF FOUNDATIONS.

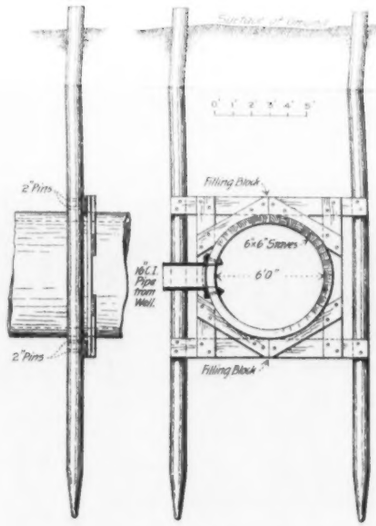
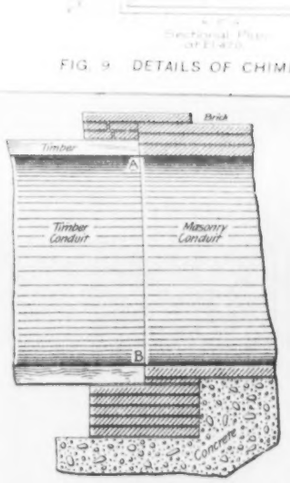


FIG. 3. PROPOSED TIMBER CONDUIT.



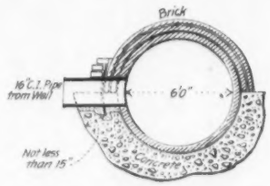


FIG. 2. CROSS SECTION OF BRICK CONDUIT.

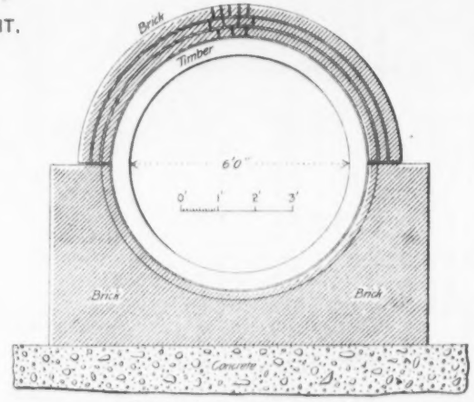


FIG. 4. PROPOSED JUNCTION OF BRICK AND TIMBER CONDUIT.

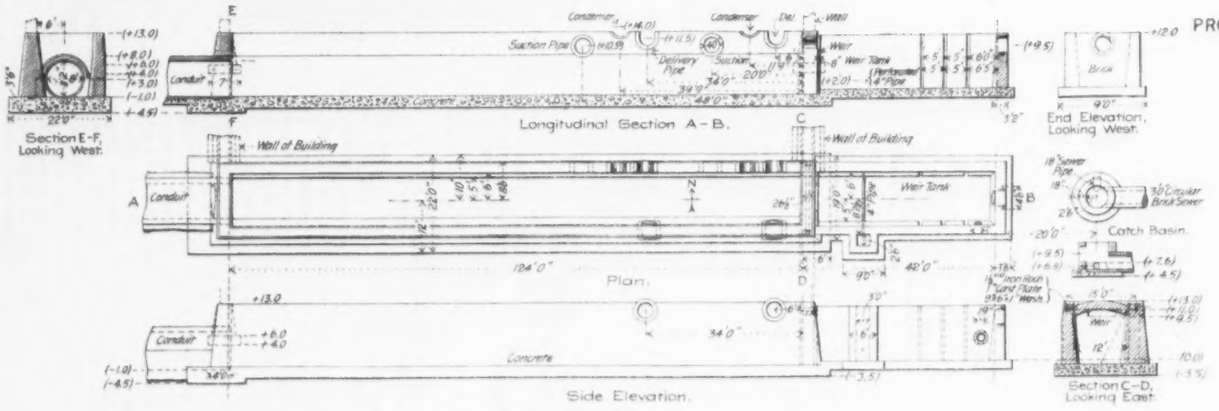


FIG. 8. DETAILS OF WET WELL AND WEIR TANK.

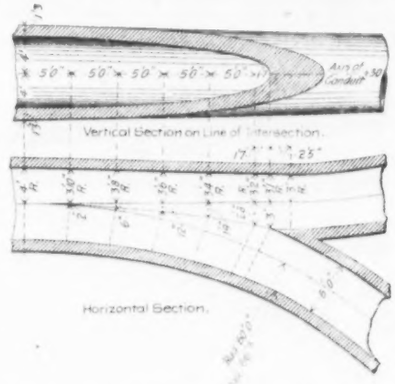


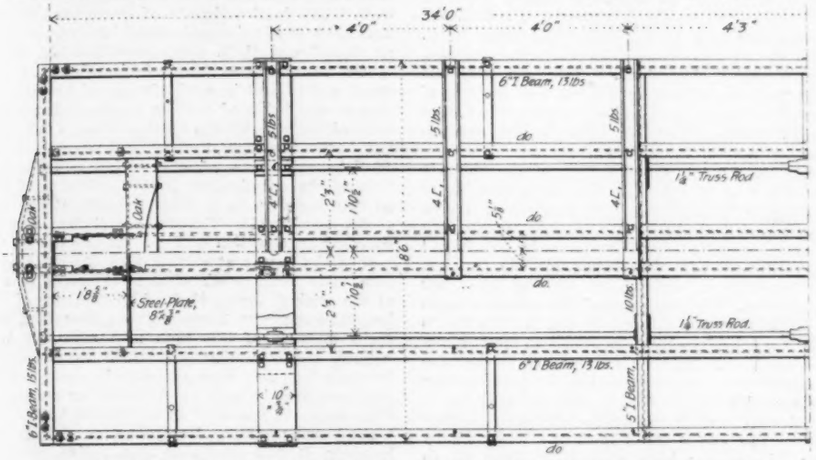
FIG. 6. JUNCTION OF CONDUIT BRANCHES.

THE NEW ARTESIAN WATER SUPPLY OF SAVANNAH, GA.

Thos. T. Johnston, Chicago, Consulting Engineer.

CHAS. HART & SONS, LITH., 36 VESEY ST., N. Y.

end sills and the six lines of longitudinal sills are of 6-in. I-beams, the former weighing 15 lbs. and the latter 13 lbs. per ft. The two center sills are depressed and do not reach to the end sill, their ends being attached to plates $\frac{3}{8} \times 8$ ins., and in line with them are two 7-in. channels, 14 lbs. per ft., extending to the end sills and carrying the draft rigging. The body bolster is a steel plate $\frac{3}{4} \times 10$ ins. Under the frame, at the truss rod hangers, are 5-in. I-beams, 10 lbs. per ft., to which are attached the hangers of the two 1¼-in. truss rods. Across the top of the frame are seven 4-in. channel irons, 5 lbs. per ft., bent to rest upon the depressed center sills, forming a seat for the cylindrical tank, wooden blocks in the channel forming the bearing. These cross bearers are bolted to the sills. The frame is covered with tongued and

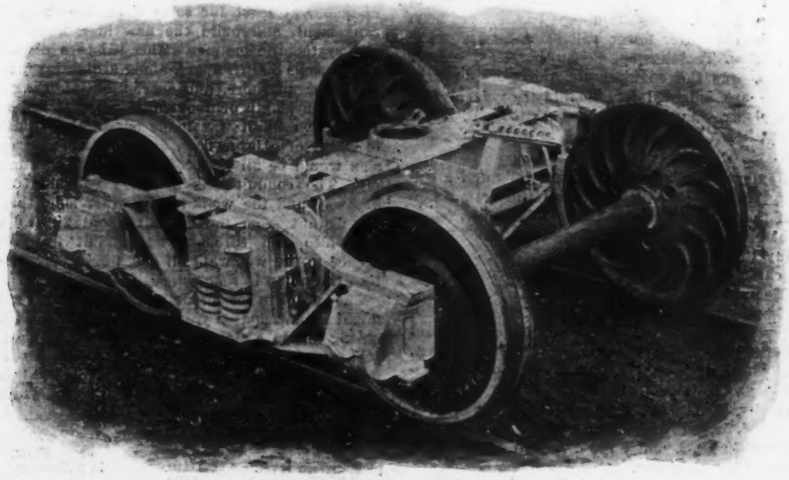


PLAN OF STEEL FRAME FOR TANK CAR; HARVEY STEEL CAR AND REPAIR WORKS.

grooved floor planks, with an opening in the center to admit the tank. The general dimensions of the car are as follows:

Length inside end sills	34 ft. 0 ins.
Width over side sills	8 ft. 6 ins.
Height of floor bove rail	3 ft. 8¼ ins.
Weight of car, without tank	19,900 lbs.
Capacity of car	60,000 lbs.
Capacity of tank	8,000 gallons
Truck, diameter of wheels	2 ft. 9 ins.
Truck wheel base	5 ft. 0 ins.
Total wheel base	24 ft. 0 ins.

The form of truck used is shown herewith, and is very similar to the Harvey steel truck illustrated in our issue of June 16, 1892, but instead



TRUCK FOR HARVEY STEEL CARS.

of a channel iron spring plank there are angle irons supporting a base plate for helical springs. The brakeshoes are hung between the wheels. The truck is of the diamond pattern with a bolster of two 10-in. I-beams, 24½ lbs. per ft.

The box and open freight cars have frames with I-beam sills, and the former have T-irons for posts, struts, braces and roof carlines, the carlines having wood filling pieces, and all parts being put together with bolts, as already noted. The floor, roof and sheathing are of wood. A box car of 60,000 lbs. capacity weighs about 29,000 lbs. Some of the cars are exhibited at the World's Columbian Exposition, as noted elsewhere.

All the cars are designed by Mr. McIlwain, who is a member of the committee of the Master Car Builders' Association, which is to present a report on the use of steel for car sills at the meeting of the Association next week. He has been an active member of the Association for 20 years.

THE NEW ARTESIAN WATER SUPPLY OF SAVANNAH, GA.

(With inset.)

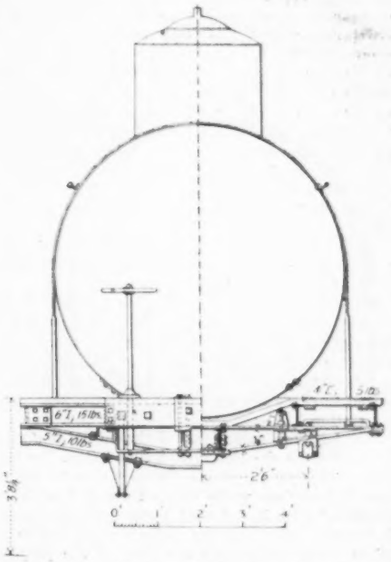
The increasing pollution of surface water supplies by domestic and manufacturing wastes has of late turned attention to underground sources and resulted in the development of water from deep wells for many towns and cities.

The city of Savannah, Ga., drew its water supply from the Savannah River from 1854, when the works were first put in operation, until 1887. The intake and pumping station were located above the city, as shown by Fig. 1, on the accompanying inset. With the growth of the city and increased pollution of the river the tidal current gradually brought to the intake an increasing amount of polluted water, until it was finally decided to sink deep wells for a new supply.

At the close of 1887 there were in use 14 artesian wells, and a fifteenth was ready for connection. The 15 wells were located near the old pumping station; 2 were 10, 12 were 6 and 1 was 4 ins. in diameter; none were over 400 ft. deep.

An analysis of the water from these wells, made by the U. S. Geological Survey, was published in the Savannah City Reports for 1887,, as follows:

	Parts per 100,000.
Chlorine	0.73
Free ammonia	None
Albuminoid ammonia	None
Solids (inorganic)	
Mostly carbonates	17.4



Cross Section of Tank Car With Harvey Steel Frame.

An analysis by Prof. C. F. Chandler was also published in the report for 1887, as follows, the results having been changed from grains per gallon to parts per 100,000:

	Parts per 100,000.
Chlorine of chlorides	1.0619
Equivalent to sodium chlorides	1.7524
Phosphates	None
Nitrates	None
Nitrogen of nitrates	10.3385
Free ammonia	None
Hardness equivalent to carbonate of lime	6.0394 before boiling; 3.0534 after boiling
Soda	1.3698
Potassia	0.2147
Lime	3.4880
Magnesia	1.2164
Oxide of iron and alumina	0.4080
Silica	3.7608
Sulphuric acid	0.8849
Equivalent to sulphate of iron	1.5044
Organic and volatile matter	1.0002
Mineral matter	21.8033
Total solids at 110° C. (230° F.)	23.0035
Biological analysis	227 colonies in 1 cu. cm.
Appearance in 2 ft. tube	Clear, colorless
Odor	None
Taste	None

In the year 1888 the entire supply was drawn from the wells, except for eight hours' pumpage from the river, the total amount pumped during the year having been 2,135,841,981 gallons, or about 5,850,000 gallons per day.

In the city reports for 1888 no mention is made of the sinking of additional wells, but it seems that three were sunk, for in the report of Mr. Jas. Manning, Superintendent of the water-works, for the year closing Dec. 31, 1889, it is stated that five wells had been bored at the works during the year, making a total of 23 wells. Regarding the supply from the wells the report states:

> These wells have furnished a good supply of water until a short time ago (the latter part of 1889), when it became necessary to open the river supply to some extent, and assist the wells in furnishing the quantity needed. This is the case, especially at low tide, as experience and observation have conclusively shown that the flow of the wells is materially affected by the tides, and there is also no doubt that the shallowness of the wells causes a filling with sand to a greater or less extent. The remedy in this case would be to sink a number of the wells deeper, to a depth which would insure a fuller supply. This has been accepted by the committee as a correct solution of the present troubles, and will be done at an early day.

In the report of Superintendent Manning for 1890 it is stated that:

The 23 artesian wells in operation had for some time failed to yield an adequate supply, and the deficiency was made up of river water, which gave general dissatisfaction.

It was decided to deepen some of the wells, and accordingly the boring on a 12-in. well at the Springfield Plantation, near the new system of wells described below, was stopped on Feb. 3, 1890, at a depth of 1,550 ft., and the machinery transferred to one of the old 10-in. wells. From Feb. 12 to April 9, 1890, this well was increased to a depth of 1,009 ft. (the previous depth having been not over 400 ft.), but the increased yield was so slight that this method of adding to the supply was abandoned. In the same year, 1890, the experiment of "shooting" the wells with an explosive lowered to its bottom was tried on three wells, but without much success.

About this time Mr. Thos. T. Johnston, Consulting Engineer, of Chicago, was engaged to report on an increase to the water supply.

From observatons Mr. Johnston concluded that by going back some distance from the river flowing wells could be obtained from the underground stream which probably flows to the ocean and eventually a sufficient pressure was actually obtained to cause the water to flow to the new pumping station.

Mr. Johnston recommended that a brick conduit be built from the Springfield Plantation, the location of the 12-in. well mentioned above, to the old pumping station, wells be sunk along its line and connected with it and that a stand-pipe be erected in the city; also that the wells then in use be cut off in order to increase the flow of the proposed new wells.

In June, 1890, it was decided that two more 10-in. wells should be sunk at the old works for immediate relief, in order that no more river water need be used, after which it was proposed that a number of wells should be put down at the Springfield Plantation and a 15,000,000-gallon pumping plant be established there.

One of these 10-in. wells, 502 ft. in depth, was connected with the old works on Dec. 29, 1890, and the other 505 ft. deep, on Jan. 27, 1891. This made a total of 25 wells at the old pumping station, of which three were 10, 20 were 6 and one 4 ins. in diameter. The total pumpage in 1890 was 2,426,646,560 gallons, or an average daily consumption of about 6,630,000 gallons, part of which was taken from the river. The average daily consumption in 1891 was about 6,500,000 gallons, or 70,000 gallons less than in 1890, but in November, 1891, it was necessary to draw water from the river again, notwithstanding the addition of the two 10-in. wells.

It was found by instrumental measurements, made June 13, 1891, that the water in well No. 1, close by the old pumping station, was 9 ft. lower than in well No. 25, 1,600 ft. distant from well No. 1.

The proposed new wells were subsequently sunk and the pumping station erected. Seven of the new wells were put in use on Dec. 9, 1892, and the balance on March 21, 1893.

The contract for the wells was awarded to E. F. Joyce, St. Augustine, Fla., for $4.50 per ft. to a depth of 430 ft. and $5 per ft. all below that depth.

There are 12 of the new wells, each 12 ins. in diameter, cased to a depth of 250 ft., the water bearing stratum being from 300 to 500 ft. below the surface. The wells are 300 ft. apart, and discharge into a conduit located close by them, as shown in plan by Fig. 1. This conduit is of brick and concrete. Alternative bids were received for building a part of the conduit of timber, as shown by Fig. 3, but it was decided to use only brick and concrete. A cross-section of the brick conduit is shown by Fig. 2, a cross-section and sectional elevation of the proposed timber conduit by Fig. 3, and the junction of the brick with the proposed timber portion by Fig. 4. It will be seen by Fig. 2 that the masonry conduit has a concrete foundation which extends up to its center line.

The details of the connection between the wells and the conduit are shown by Fig. 5, and also in a general way on the sections of the masonry and proposed timber conduit, Figs. 2 and 3. Each well may be shut out by means of a 16-in. gate.

As shown by plan and vertical section in Fig. 6, the conduit at a point opposite the pumping station curves in toward the station from each extremity and enlarges at the point of junction to a diameter of 8 ft. The curve of the axis of the conduit has a radius of 60 ft.

The 8-ft. section of the conduit, which is 50 ft. long, terminates at the pumping station in a wet well. Fig. 7 is a general plan of the station, showing the location of the wet well, suction pipes, pump foundations, boilers, condensers, delivery mains and their connection with the 42-in. force main and the weir tank used for measurements during tests.

The wet well extends across the whole front of the pumping station, which gives an interior length of about 124 ft., and the weir tank extends beyond the building with an interior length of about 40 ft. The bottom width of the wet well is 8 ft. and of the weir tank 10 ft., both being about 12 ft. wide at the top. Plans, elevations and sections, with detailed dimensions of both the well and weir tank, are shown by Fig. 8. The bottoms of both the well and tank are of concrete, the former 2½ ft. and the latter 2 ft. thick, in each case extending beneath the side walls.

A plan, elevations and details of the chimney are shown by Fig. 9. The chimney is of brick on a concrete foundation. The concrete is 28 ft. square and 3 ft. thick. Above the concrete is a brick sub-base 8 ft. high, as shown in Fig. 9, and above the sub-base the chimney is 135 ft. high, the lower 35 ft. being square and the upper 100 ft. circular. The thickness of the chimney walls at different stages is shown in Fig. 9. The flue is lined for a height of 100 ft., giving an inside diameter of 5½ ft. There is an entrance to the base of the chimney, shown in the two elevations and by the special detail in Fig. 9. The chimney has a metal cap, cast in segments with bolted flange joints. The cap is fastened to the brickwork by four 1-in. anchor bolts each 1 ft. long, all as shown in detail in Fig. 9.

Two 12,000,000-gallon Gaskill pumping engines have been placed at the new station, and six horizontal return tubular boilers, each to evaporate 3,500 lbs. of water per hour with 350 lbs. of selected coal.

The contract price for the boilers was $13,875; for the pumps, $92,000; for the masonry conduit, $27,500, excepting Section C, which was at the rate of $10.45 per ft. additional.

The well system and conduit may, as the city grows, and as more water is used, be extended along the road which runs toward and finally near to the old pumping station.

The 42-in. and 36-in. force main will eventually connect with a stand-pipe in the city, as shown in the map, Fig. 1. This stand-pipe has not yet been built, the old water tower still being used.

Mr. Thos. T. Johnston, Consulting Engineer, of Chicago, was the engineer for the work, and to him we are indebted for the illustrations and to him and Mr. Jas. Manning, Superintendent of the Savannah water-works, for the information given above.

An extensive system of artesian wells and a collecting conduit or gallery furnish the water supply of the Artesian Water Co., of Memphis, Tenn., and has been described and illustrated in our issues of May 10, 1890, and Sept. 12, 1892. Mr. Johnston was chief engineer of the earlier construction of the Memphis system, the late Mr. Thos. J. Whitman having been consulting engineer. Mr. Johnston was subsequently made consulting engineer, and conducted the construction subsequent to August, 1891, which developed a permanent flow exceeding 25,000,000 gallons per day.

The city of Lowell, Mass., is now putting in a system of driven wells, experiments having been conducted in 1892, under the direction of Mr. Geo. Bowers, City Engineer.

The following additional information, relating principally to the new wells, has been sent by Mr. Johnston:

The strata through which the wells are bored are, geologically, cretaceous or later formation. Sands and clay are met until a depth of about 250 ft., where a cherty limerock is found. The rock varies in character at greater depths. The first water is found at about 325 ft., and an additional quantity is found every few feet until the depth has exceeded 500 ft. The water bearing rock is uniformly a very porous limerock, or rather one full of cavities, very similar to the rock outcrop from which the mammouth Suwanee springs, in northern Florida, flow. Water is occasionally found at depths below 500 ft., but not in sufficient quantity to justify the deeper wells. The 12 wells of the new water-works average 500 ft. in depth. They are cased to the rock, about 250 ft., with a casing of 12 ins. internal diameter. Below this there is no casing, the hole being simply drilled in the rock so as to have a clear inside diameter of 12 ins. The casing was driven, the sands and clay being removed by the use of sand buckets. The drilling was all done by the ordinary spudding process.

The general hydraulic situation pertaining to the water bearing-strata is of some interest. The first well, bored in the vicinity of Savannah, showed that the water in the wells found its static level at an elevation of 41 ft. above mean low-tide, which is the commonly accepted datum there. Subsequent wells bored in a wide range of country adjacent, and being of various depths, indicate the same elevation. After a number of wells had been bored, the elevation of this static level in intermediate wells was, of course, lowered. At the time of the examination in 1890, about 6,000,000 gallons per day were being pumped at the old works (see Fig. 1). The static level then was reduced to an elevation of 7 ft. At the site of the new works it was at elevation 28 ft., while at a point nine miles south of the old works it was at the original figure, 41 ft. The influence of the heavy pumpage at Savannah was, therefore, felt for a distance of less than nine miles. It was noticed, however, that for equal distances the influence was felt more radically in wells toward the ocean than in wells equidistant from the ocean. This led to the theory of an oceanward flow in the water-bearing strata. Regardless of the theory, however, it was concluded that a line of wells parallel to the ocean would be the most effective method of distribution.

The wells at the old works had been bored at random on the city property, the result being a bunch of wells drawing water from a spot in the water-bearing strata, thus creating unnecessary velocities through the cavities in the rock, and consequent loss of head, and limiting the flow that could result from a stated depression of the static level. Furthermore, the wells were connected to a long cast iron suction pipe laid to no grade, and a source of trouble on account of leaks. Any increase of capacity required that this suction pipe be replaced.

All things considered, such as force main, and adaptibility to extensions, it was thought wise to abandon, at least for some time, the existing arrangement, and build the new in a more logical and systematic manner. This led to a disposition of the wells 300 ft. apart, along a highway parallel to the ocean shore, and susceptible of being used through a length of about nine miles, if necessary. The new conduit was made of sufficient diameter to admit of a large flow, so that its simple extension would be all required for enlarged water supply. The conduit was made at one side of the highway and the wells at the other side, they being distant from the conduit about 20 ft. They flow into and through the conduit by gravity, thence to the wet well, all gases being set free before the pump is reached.

The problem of predetermining the flow that might be anticipated from a given number of wells strung out in a line was, of course, the most important presented. The Springfield well, in Gwinnett St., about 2,000 ft. east of the new pumphouse (Fig. 1), was made the subject of examination. It flowed as follows:

Elevation of static or piezometric level.	Date.	Flow, in gallons, per day.
27.67	1890	....
25.67	1890	482,000
24.40	1891	623,000
22.77	1890	1,000,000
22.68	1891	977,000
21.80	1891	1,133,000
21.79	1891	1,172,000
20.57	1890	1,360,000
13.00	1890	2,500,000

It was estimated that about 3,000,000 gallons per day could be obtained with the static level reduced to elevation 7 ft., which reduction is practicable at the pump house as constructed. The old

wells spread over a width of country about 1,700 ft. at its widest dimension. There was every reason to believe that any one location of a well was as good as another. At the old wells the flow at elevation 7 ft. was about 6,000,000 gallons per day. It was certain that the occupation of a wider expanse of country would result in an increased flow.

It is known that the flow over a weir with end contractions is influenced in some measure, the depth being constant, as the end contractions become more remote. And when the weir is long enough, the end contractions may be neglected in computations. There is an analogy between this state of affairs and the conditions attending a line of wells across the country. Consider two adjacent wells, 300 ft. apart. The two will flow very much less than twice the flow of one. It is the case of end contractions close together. Add a third well, a fourth, etc., then there is an approximation to a condition at which the addition of each successive well will add a constant quantity of flow. This is analogous to the condition of remote end contractions. In the light of the flow of the Springfield well, the condition of the piezometric surface of the surrounding region, the analogy to the weir and the flow at the old wells, it was concluded that if a line of wells embracing a width of 3,500 ft. were bored, a flow of 10,000,000 gallons per day might be anticipated. Careful daily weir measurements were made of the flow of each well as it was bored, the results continually justifying the original conclusions. The conduit was therefore built to a length of 3,645 ft., and collects water from 12 wells, 300 ft. apart.

Dec. 9, 1892, the work was so far completed that the seven wells nearest the pump house were put in service. These embraced a length of line of 1,800 ft., nearly the same as at the old wells. The level of the water in the wet well was reduced to elevation 8 ft., which of course measured the static level in the seven wells. The flow was 6,500,000 gallons per day. It is interesting to note that at this time the static level in wells 10, 11 and 12 were at elevations respectively 14.93, 15.96 and 16.20 ft.

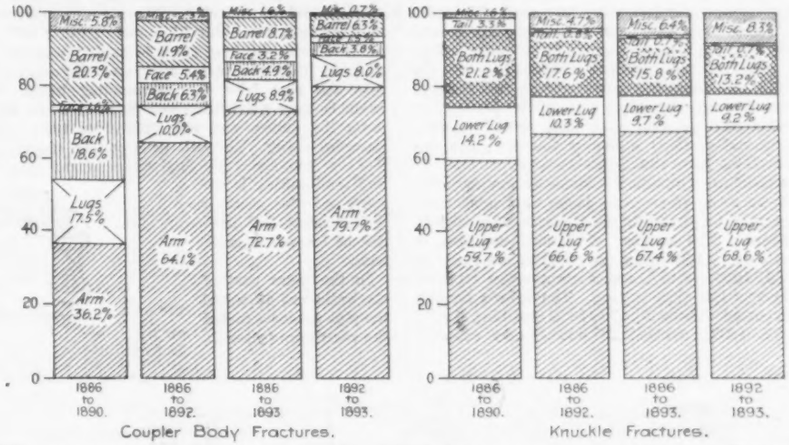
March 21, 1893, the 12 wells were put in service, and with the level of water in wet well at elevation 8 ft. the flow was 9,500,000 gallons.

There is much reason to believe that the supply is of a permanent nature, the strongest hopes being derived from the fact that the Suwanee springs, a very similar water and a natural artesian well, have flowed for ages. Besides, the experience of the past few years at and near Savannah affords no indication of a diminution of water available. Quite to the contrary, there is much reason to believe that the supply can be very largely augmented, possibly to meet the requirements of a very large city.

THE RECORD OF JANNEY COUPLER BREAKAGES.

The accompanying tables present a statement of the percentage of breakages in different parts of the Janney car coupler, and its knuckle, as returned to the manufacturers, the McConway & Torley Co., by the various railways using this coupler. The percentage is given for three periods: First, the period beginning Jan. 1, 1886, and ending March 31, 1892; second, the year from March 31, 1892, to March 31, 1893; and, third, the whole period from Jan. 1, 1886, to April 1, 1893. Thus the figures for period 1, are a repetition of the similar figures published in our issue of May 12, 1892. Period 2 represents most closely current experience in coupler breakages, being for the 12-month which ended ten weeks ago. Period 3 is the whole time since the coupler has been in use. As the figures are given for each railway in detail, a comparison of the experience of different roads is easily made. It will be seen that in general the figures agree quite closely on the different roads, thus furnishing good proof of the completeness and practical accuracy of the record as made up. At the same time it is true that considerable variations are to be noted. One or two companies have had a "peck of trouble," for instance, with the tail bolt head breaking through, at certain periods, and others show an abnormally high percentage of breakages of the head from the barrel.

The illustrations show typical breakages of each of the classes given in the table, for both couplers and knuckles. To ascertain as fully as possible the tendency of each part of the coupler and knuckle toward decreased or increased durability, we have given under each cut the percentage of total breakages of the class illustrated for four different periods: First, the period from the introduction of the coupler to Jan. 1, 1890; second, the whole period from introduction to April 1, 1892; third, the period from introduction to April 1, 1893, and, last, the percentage of breakages for the year ending April 1, 1893. The last figure, therefore, indicates most closely the prevailing course of breakages at the present time.

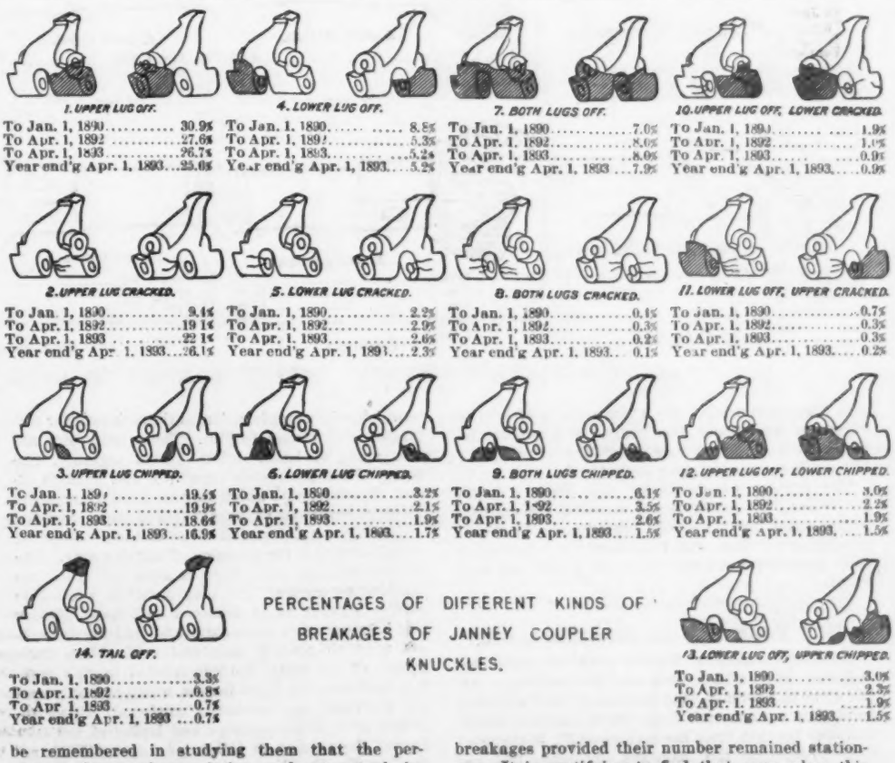


GRAPHICAL SHOWING OF PERCENTAGE OF BREAKAGES OF DIFFERENT PARTS OF COUPLER BODIES AND KNUCKLES FOR FOUR DIFFERENT PERIODS.

To make the changes in percentage of breakage of the different parts as clear as possible, we have reclassified the breakages and plotted the percentages for each of the four periods; and the result is shown in the accompanying diagrams. It must be remembered in studying them that the percentage figures show relative, and not actual, increase and decrease.

The most striking fact is the steady increase in arm breakages, which, at present, amount to four-fifths of all breakages of coupler bodies. The cause of these increased arm breakages is a matter on which opinion is somewhat divided; but the shock from coupling with another M. C. B. coupler, the side strain in passing sharp curves, and the sliding past each other of two M. C. B. couplers coming together with the knuckles closed are the causes generally assigned for arm breakages. Unfortunately, no figures are at present available, showing the actual percentage of annual breakages of couplers in proportion to the number in service. The best estimate we can make from the figures given in our issue of March 12, 1892, is 4% to 8% of the number of couplers in service. If these figures are accepted as correct, then out of every 100 Janney couplers in service, from three to seven are sent to the scrap heap every year for arm breakage.

In examining the percentage of breakages of other parts of the coupler bodies, it must be remembered that the doubling of the percentage of arm brakages would halve the percentage of all other breakages provided their number remained stationary. It is gratifying to find that even when this is taken into account there has been an actual decrease in the breakages of the barrel, which is a serious breakage because of the liability to train wrecks through the falling of the coupler on the track. There has also been a decrease in the

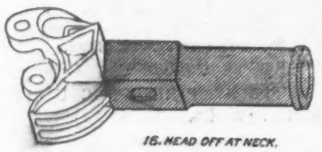

1. UPPER LUG OFF.
To Jan. 1, 1890 ..... 30.9%
To Apr. 1, 1892 ..... 27.6%
To Apr. 1, 1893 ..... 26.7%
Year end'g Apr. 1, 1893...25.0%
4. LOWER LUG OFF.
To Jan. 1, 1890 ..... 8.8%
To Apr. 1, 1892 ..... 5.3%
To Apr. 1, 1893 ..... 5.2%
Year end'g Apr. 1, 1893... 5.2%
7. BOTH LUGS OFF.
To Jan. 1, 1890 ..... 7.0%
To Apr. 1, 1892 ..... 8.0%
To Apr. 1, 1893 ..... 8.0%
Year end'g Apr. 1, 1893 ...7.9%
10. UPPER LUG OFF, LOWER CRACKED.
To Jan. 1, 1890 ..... 1.9%
To Apr. 1, 1892 ..... 1.1%
To Apr. 1, 1893 ..... 0.9%
Year end'g Apr. 1, 1893.... 0.9%
2. UPPER LUG CRACKED.
To Jan. 1, 1890 ..... 9.4%
To Apr. 1, 1892 ..... 19.1%
To Apr. 1, 1893 ..... 22.1%
Year end'g Apr. 1, 1893...26.1%
5. LOWER LUG CRACKED.
To Jan. 1, 1890 ..... 2.2%
To Apr. 1, 1892 ..... 2.9%
To Apr. 1, 1893 ..... 2.6%
Year end'g Apr. 1, 1893....2.3%
8. BOTH LUGS CRACKED.
To Jan. 1, 1890 ..... 0.1%
To Apr. 1, 1892 ..... 0.3%
To Apr. 1, 1893 ..... 0.2%
Year end'g Apr. 1, 1893... 0.1%
11. LOWER LUG OFF, UPPER CRACKED.
To Jan. 1, 1890 ..... 0.7%
To Apr. 1, 1892 ..... 0.3%
To Apr. 1, 1893 ..... 0.3%
Year end'g Apr. 1, 1893.... 0.2%
3. UPPER LUG CHIPPED.
To Jan. 1, 1890 ..... 19.4%
To Apr. 1, 1892 ..... 19.9%
To Apr. 1, 1893 ..... 18.6%
Year end'g Apr. 1, 1893...16.9%
6. LOWER LUG CHIPPED.
To Jan. 1, 1890 ..... 3.2%
To Apr. 1, 1892 ..... 2.1%
To Apr. 1, 1893 ..... 1.9%
Year end'g Apr. 1, 1893....1.7%
9. BOTH LUGS CHIPPED.
To Jan. 1, 1890 ..... 6.1%
To Apr. 1, 1892 ..... 3.5%
To Apr. 1, 1893 ..... 2.6%
Year end'g Apr. 1, 1893... 1.5%
12. UPPER LUG OFF, LOWER CHIPPED.
To Jan. 1, 1890 ..... 3.0%
To Apr. 1, 1892 ..... 2.2%
To Apr. 1, 1893 ..... 1.9%
Year end'g Apr. 1, 1893.... 1.5%
14. TAIL OFF.
To Jan. 1, 1890 ..... 3.3%
To Apr. 1, 1892 ..... 0.8%
To Apr. 1, 1893 ..... 0.7%
Year end'g Apr. 1, 1893 ...0.7%
PERCENTAGES OF DIFFERENT KINDS OF BREAKAGES OF JANNEY COUPLER KNUCKLES.
13. LOWER LUG OFF, UPPER CHIPPED.
To Jan. 1, 1890 ..... 3.0%
To Apr. 1, 1892 ..... 2.3%
To Apr. 1, 1893 ..... 1.9%
Year end'g Apr. 1, 1893.... 1.5%

breakages of the back and in the miscellaneous class. The lugs and face breakage have remained about the same.

Turning to the knuckle fractures, we find that the upper lug is the weakest point, being the sole cause of failure in 68 out of every 100 broken knuckles. Adding to this the breakages in which both upper and lower lugs are affected, it appears that in every 100 broken knuckles 82 have injured or missing upper lugs. As we have before stated, the droop of the car end is the chief cause of the preponderance of upper lug fractures. The small percentage of lower lug fractures without injury to the upper lug occur probably when a new car without load, and carrying its drawbar pretty high, comes against a loaded car with badly drooped end. In this case the lower lug of the knuckle may have to take the whole force of the blow. The miscellaneous knuckle fractures, which include worn knuckles, show a steady increase, but the tail fractures have nearly disappeared.

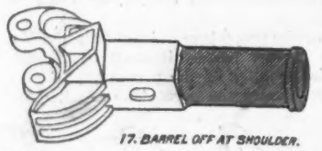
The number of couplers covered by the statistics which we have given is so large that much confidence may be placed in the essential accuracy of the figures. The number of Janney couplers in use on Jan. 1, 1890, was (as given in our issue of Feb. 15, 1890) 45,617, and their average term of service was less than a year. The figures for the second period, closing April 1, 1892 (see Eng. News, May 12, 1892), covered 237,434 Janney couplers and coupler knuckles, the average term of service of which was nearly two years. We are not informed as to the number of couplers covered by the statistics for the year just closed.

The McConway & Torley Co. deserve much credit for their enterprise in securing and making public exact records of the performance in actual service of all their couplers; and the information thus gained cannot fail to be of much practical value.



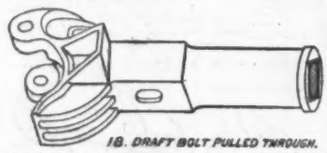
16. HEAD OFF AT NECK.

To Jan. 1, 1890	6.1%
To Apr. 1, 1892	2.6%
To Apr. 1, 1893	2.3%
Year ending Apr. 1, 1893	2.2%



17. BARREL OFF AT SHOULDER.

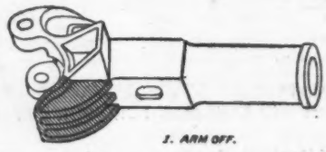
To Jan. 1, 1890	12.2%
To Apr. 1, 1892	6.2%
To Apr. 1, 1893	3.9%
Year ending Apr. 1, 1893	2.1%



18. DRAFT BOLT PULLED THROUGH.

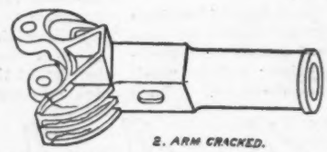
To Jan. 1, 1890	2.0%
To Apr. 1, 1892	3.1%
To Apr. 1, 1893	2.5%
Year ending Apr. 1, 1893	2.0%

Barrel Fractures.



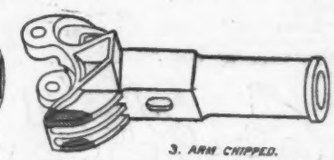
1. ARM OFF.

To Jan. 1, 1890	32.7%
To Apr. 1, 1892	51.3%
To Apr. 1, 1893	52.0%
Year ending Apr. 1, 1893	52.7%



2. ARM CRACKED.

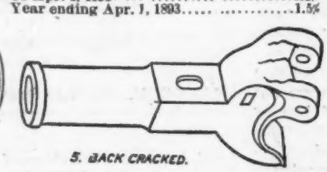
To Jan. 1, 1890	0.6%
To Apr. 1, 1892	1.2%
To Apr. 1, 1893	8.0%
Year ending Apr. 1, 1893	13.1%



3. ARM CHIPPED.

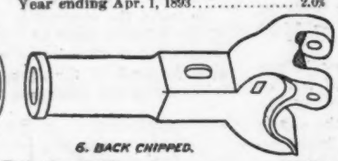
To Jan. 1, 1890	2.9%
To Apr. 1, 1892	11.6%
To Apr. 1, 1893	12.1%
Year ending Apr. 1, 1893	12.0%

Arm Fractures.



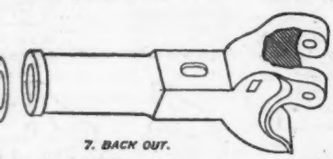
5. BACK CRACKED.

To Jan. 1, 1890	12.5%
To Apr 1, 1892	5.1%
To Apr. 1, 1893	3.4%
Year ending Apr. 1, 1893	2.0%



6. BACK CHIPPED.

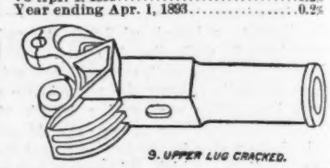
To Jan. 1, 1890	5.0%
To Apr. 1, 1892	0.7%
To Apr. 1, 1893	0.5%
Year ending Apr. 1, 1893	0.3%



7. BACK OUT.

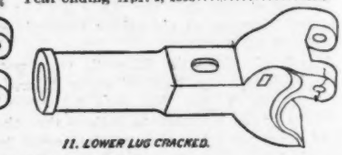
To Jan. 1, 1890	1.1%
To Apr. 1, 1892	0.5%
To Apr. 1, 1893	1.0%
Year ending Apr. 1, 1893	1.5%

Face and Back Fractures.



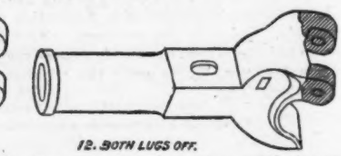
9. UPPER LUG CRACKED.

To Jan. 1, 1890	4.0%
To Apr. 1, 1892	3.4%
To Apr. 1, 1893	2.2%
Year ending Apr. 1, 1893	1.3%



11. LOWER LUG CRACKED.

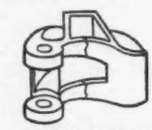
To Jan. 1, 1890	—
To Apr. 1, 1892	0.1%
To Apr. 1, 1893	—
Year ending Apr. 1, 1893	—



12. BOTH LUGS OFF.

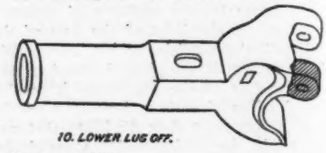
To Jan. 1, 1890	4.8%
To Apr. 1, 1892	2.3%
To Apr. 1, 1893	1.6%
Year ending Apr. 1, 1893	1.0%

Lug Fractures.



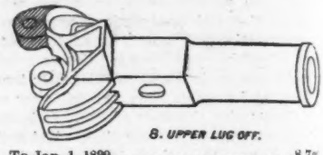
4. FACE CRACKED.

To Jan. 1, 1890	1.6%
To Apr. 1, 1892	5.4%
To Apr. 1, 1893	3.2%
Year ending Apr. 1, 1893	1.5%



10. LOWER LUG OFF.

To Jan. 1, 1890	—
To Apr. 1, 1892	0.1%
To Apr. 1, 1893	0.2%
Year ending Apr. 1, 1893	0.2%



8. UPPER LUG OFF.

To Jan. 1, 1890	8.7%
To Apr. 1, 1892	4.1%
To Apr. 1, 1893	4.9%
Year ending Apr. 1, 1893	5.5%

Face and Back Fractures. Lug Fractures.

PERCENTAGES OF DIFFERENT KINDS OF BREAKAGES OF JANNEY COUPLER BODIES.

HOW VENETIAN WELLS WERE MADE.

The water supply of Venice, with tidewater circulating everywhere between its multitude of islands, has been a serious problem to the Venetians from time immemorial. Since 1884 excellent water has been brought from the springs of St. Ambrogio, near Treviso on the mainland, by pipes laid on the bottom of the lagoon, and it is then distributed according to modern methods by pipes. Previous to that date the supply came from the more or less sewage-polluted River Brenta and was conveyed to the city in open barges; or it was drawn from wells in the city collecting the roof water.

The construction of these wells was of course an important consideration, and in a late report the English Consul-General at Florence, Sir D. Colnaghi, describes the method as follows: "The well consists of a basin more or less wide, according to the conditions of the place, closed all round and at the bottom by a stratum or bank of clay to prevent the filtration of salt water from the outside. In the inner part of this basin is built a pipe (canna) of baked clay, which is placed on a slab of stone (piatto) laid on the clay. The pipe is constructed of circular bricks (pozzali) joined together with cement of pure clay and sand, to render them permeable, so that the water may pass through them into the pipe from the surrounding basin. The basin is then filled with marine sand to be taken from the dunes, and not with river sand which putrefies easily. The salt sand can be easily purified by frequently putting sweet water into the well and taking it out until all the sand is well washed and purified of its salt ingredients.

In the inner part of the basin and all round the pipe are constructed the reservoirs (cassoni), in which rain water is collected through exterior perforated slab stones (sigilli). These reservoirs are also made of baked bricks joined together, like those of the pipe, with pure clay and sand to allow the water with which they are filled to percolate. They are covered with large plates of stone or vaults.

One of the greatest difficulties in the construction of such a well is the selection of suitable clay. The quality of clay used here is obtained from the neighboring moors. The clay must be worked in such a manner as to render a soft mass without any heterogeneous substance, and laid on the subsoil with all possible care and skill. Even here, where all the wells are constructed in this way, few workmen are fitted for the work, and only special workmen are constantly employed. Upon the proper or improper molding and laying of the clay depend the success or failure of a well. With regard to the St. Ambrogio water now distributed at Venice, it is most satisfactory to state that it is of a high degree of purity, needs no filtration, is cool in summer, and is entirely approved by all consumers.

A ROMAN LIFT-BRIDGE.

A lift-bridge of somewhat peculiar design has been recently built across the River Tiber, about 1¼ miles from the city of Rome. The engineer was Signor A. Vescovali, chief engineer to the Hydraulic Service of Rome. The bridge proper is of wrought iron and is 503 ft. long from end to end and 30 ft. 5 ins. wide. It has four spans of 114 ft. 8 ins. each, with a central span of 49 ft. 2 ins. covered by a lifting floor of 41 ft. 7 ins. operated from short cantilevers. The piers are made up of two cylinders, each filled with concrete; the abutments are masonry.

The lifting floor is 19½ ft. wide and moves through an angle of 75° from a pivot on one side. It is provided with an extension, or counterbalance, 38 ft. 3 ins. long with a 12-ton counterweight at one end, which almost balances the weight of the leaf or floor. On the moving part are two segments of 9 ft. 8 ins. radius, and over these pass flat steel ropes connected with two floating counterweights, 10 ft. 4 ins. by 3 ft. 6 ins., situated inside the pier cylinders. These floating weights are inside two other cast iron cylinders each 3 ft. 9 ins. in diameter. These latter cylinders can be filled or emptied of water by means of pipes and valves on the bridge.

To open the draw the outer cylinders are emptied and the counterbalance cylinders sink and raise the leaf to the angle mentioned. To shut the draw the water is admitted and the inner cylinders are floated again, and the leaf descends by gravity. The whole movable part weighs about 74 tons and

Relative Frequency of Breakages in Different Parts of Janney Freight Coupler Bodies. Determined by Percentage Computations from Total Number of Breakages Reported by Each Railroad from Jan. 1 to March 31, 1893. (Period No. 1 is from Jan. 1, 1886, to March 31, 1892. Period No. 2 is from April 1, 1892, to March 31, 1893. Period No. 3 is from Jan. 31, 1886, to March 31, 1893.)

Nature of Defect.	Period.	Gen'l Ave.	Ally. Val'y	Balt. & Ohio.	C., B. & Q.	C., C., C. & St. L.	C'nda Cattle Car Co.	Ch'go, Milw. & St. P.	Ch'go & N. W.	Ch'go, R. I. & Pac.	Ches. & Ohio.	Grand Rap. & Ind.	Lake Shore & M. S.	Le'igh Val'y.	Mich. Cent.	No'n Cent.	N. Y. C. & H. R.	N. Y., Ch'go & St. L.	N. Y., L. E. & W.	No'thern Pa'fic.	Penn. R. R.	Pa. Co. N. W.	Pa. Co. S. W.	Phil., Wilm. & Balto.	Rich. & Dan.	Union Pac.	West Shore.	West. N. Y. & Penn.	Wis. Cent.	Misc.
Arm off. Fig. 1.	1	51.28	23.45	44.01	59.40	50.69	42.43	61.42	56.89	40.56	52.00	42.86	43 29	43.94	.....	69.01	28.94	16.67	25.76	67.41	63.82	60.54	51.10	68.12	53.87	51.02	17.17	18.65	47.06	40.89
	2	53.69	31.88	51.76	63.89	33.33	39.29	61.99	61.77	51.24	37.59	60.65	33.21	47.27	35.56	48.69	43.87	30.40	21.67	65.12	67.74	50.88	58.90	73.73	41.27	71.18	56.76	25.77	34 62	45.81
	3	52.6-	28.77	48.13	61.76	41.60	40.98	61.76	58.58	47.58	44.36	57.34	36.84	44.66	37.56	55.52	34.35	23.93	24.15	63.20	65.92	54.51	55.73	71.27	36.58	62.03	27.91	21.04	39 53	44.95
Arm cracked. Fig. 2.	1	1.28	1.23	1.33	1.03	1.60	21.21	0.54	0.89	1.76	1.00	.....	3 00	4 04	.....	0.54	3.57	4.55	0. 6	0.37	0.47	1.70	0.31	.....	0.70	.....	4.04	4.15	3.92	2.06
	2	13.76	13.76	8.23	5.89	33.33	10.71	10.72	8.82	10.82	16.31	11.47	34.64	1.82	28 89	23.99	15.71	30.40	9.71	1.66	5.72	21.63	11.98	3 95	29.40	1.70	.....	24.74	3.85	17.92
	3	8.01	9.13	5.00	3.58	17.68	16.39	6.58	3.63	8.33	9 40	9.33	23.25	3.56	28.89	16.25	7.84	18 21	4.29	1.03	3.29	14.12	7.23	2.22	9 88	0.93	2.94	11.14	3.86	15 17
Arm chipped. Fig. 3.	1	11.57	43 21	30.67	6.61	16.22	18.18	21.13	9.33	18.34	16.00	7.14	24.17	19.19	.....	9.32	22.31	27.27	7.32	12.72	6.07	10.23	8.65	1.81	10.09	.....	15.15	32.64	5.83	12.24
	2	12.59	21.74	21.18	12.07	17.19	46.43	22 24	19.75	22.31	14.18	9.81	17.32	18.18	17.04	9 02	18 20	22.97	12.59	13.95	6.13	9.61	10.03	4.24	11.51	8.47	18.92	27.81	19.23	12.22
	3	12.14	49.68	25.62	9.47	16.71	31.15	21.79	12.94	21.22	15.04	9.33	19.78	18.97	17.04	9.15	20.82	25.00	9.40	13.13	6.10	9.84	9.47	3.17	10.62	4.63	16.18	31.04	13.95	12.22
Face cracked. Fig. 4.	1	5.44	7.41	.....	3.20	8.20	.....	5.03	4.22	4.23	7.20	14.29	10.90	11.11	.....	2.82	9 79	13 61	4.98	0 74	2.87	9.89	6.52	1.81	8.69	.....	11 11	9.81	3.92	9.12
	2	1.46	0.73	1.18	0.28	2.08	.....	0.43	0.42	0 94	0.71	1.64	2.93	1.82	2.22	1.66	1.92	2.70	1.17	0.33	0.84	2.65	0.32	2.26	0.79	1.70	2.70	6.19	.....	3.56
	3	3.22	3.24	0.63	1.67	5.10	.....	2.50	2.91	1.84	3.76	4.00	5.80	9.09	2.22	2 05	6 91	7.86	3.47	0.53	1.64	5.38	3.01	2.06	5.75	0.53	8.82	8.62	1.55	4.53
Back cracked. Fig. 5.	1	5.13	4.94	4.00	1.86	3.92	3.03	1.26	0 22	1.06	2.40	.....	3 00	7.07	.....	1.41	7.07	15.91	21.13	1.48	3.11	2 84	3.46	.....	3.29	4.08	22.23	8.29	.....	3.05
	2	2.03	6.52	1.18	0.47	2.08	.....	0.74	0 42	0.60	1.42	1.64	2.40	9.09	2.22	1.90	4.21	2.03	13.22	0.33	1.08	1.91	1.40	0 28	1 59	1 70	.....	3.09	.....	1.53
	3	3.40	5.94	2.50	1.13	2.99	1.64	0.95	0 29	0.73	1.88	1.33	2.62	7.71	2.32	1.73	6.04	8.57	18.01	0 87	2.02	2.26	2.24	0.16	2.65	2.78	16 18	6.55	.....	1.90
Back chipped. Fig. 6.	1	0.72	.....	4.00	0.21	1.42	3.03	0.18	.....	0.53	1.60	.....	0.79	0 51	.....	0.47	3.26	6.06	0.88	0.37	0.23	0.32	0.63	0.36	1.17	.....	4.04	2.50	.....	0.26
	2	0.31	.....	.....	0.09	0 52	.....	.....	.....	0.87	.....	.....	0.62	1.82	0.7	.....	0.19	.....	0.90	.....	0.20	0 44	0.43	.....	0.40	.....	.....	.....	.....	.....	0.14
	3	0.49	.....	1.87	0.15	0 97	1 64	0.07	.....	0.77	0.75	.....	0.68	0.79	0.74	0.16	2.15	2.86	0.89	0.17	0 21	0.40	0.51	0.16	0.89	.....	2.94	1.72	.....	0.14
Back out. Fig. 7.	1	0.51	.....	.....	0.52	0.36	.....	0.18	.....	0.35	.....	.....	0.16	1.01	.....	.....	0.87	.....	1.11	.....	0.43	0.24	1.10	1.81	0.94	.....	.....	.....	.....	.....	0 52
	2	1.48	0.73	.....	1.2-	1.35	.....	0.86	0.84	0.40	2.13	3.28	0.35	3.63	1 48	2.14	0.96	.....	2.25	1 00	2 20	1.57	2.16	1.41	1.98	.....	.....	.....	1.28	1.87
	3	1 05	0.46	.....	0.88	0.35	.....	0.59	0.29	0.39	1.13	2.67	0.28	1.58	1.48	1.42	0.90	.....	1.56	0.53	1.38	1.07	1.73	1.59	1.23	.....	.....	.....	0.78	1.22
Upper lug off. Fig. 8.	1	4.09	2.47	4.00	4.13	2.32	3.03	1.17	3 78	2.12	5.60	21.43	1.89	2.02	.....	4.22	1.42	2.27	3.69	3.71	5.00	6.24	5.82	6.89	4.46	4.08	1.01	0.52	7.85	8.56
	2	5.53	10.87	9.41	4.21	3.30	.....	1.54	1.68	1.60	14.18	3.28	1.33	1.82	1.48	6.65	2.68	4.06	9.53	7.97	7.08	5.80	9.17	7.63	5.95	6.77	8.11	3.09	5.13	6.56
	3	4.89	7.76	6.87	4.17	2.82	1.64	1.39	3.05	1.74	10.15	6.67	1.53	1.98	1.48	5.83	1.87	3.21	5.99	5.95	6.11	6.02	7.80	7.30	5.01	5.55	2.94	1.38	6.20	6.97
Upper lug cracked. Fig. 9.	1	0.15	.....	.....	.....	.....	.....	.....	.....	.....	0.80	.....	.....	0.51	.....	.....	0.11	0.76	0.17	.....	0.10	0.63	0.16	.....	.....	.....	.....	.....	1.04	.....	0.28
	2	0.19	1.45	1.18	.....	.....	.....	0.08	.....	0.07	0 71	.....	0.64	.....	.....	.....	0.19	.....	0.16	0.44	0.11	.....	.....	.....	0.40	.....	.....	.....	.....	.....	0.17
	3	0.17	0.91	0.63	.....	.....	.....	0 03	.....	0.10	0.75	.....	0.40	0.39	.....	.....	0.14	0.38	0.18	.....	0.13	0.52	0.13	.....	0.15	.....	.....	0.89	.....	.....	0.18
Lower lug off. Fig. 10.	1	3.39	4.94	4.00	3.72	3.03	3.03	2.31	3.78	4.06	1.60	.....	2.87	1.01	.....	0.94	6.53	1.51	7.55	3 34	2.30	1.05	3.53	2 54	2.35	8.17	5.05	2.59	.....	5.99
	2	1.25	3.62	.....	0.91	1.04	.....	0.49	2.10	1.00	1 42	4.92	0.62	3.63	.....	0.95	1.72	1.35	3.06	1.33	1.07	0.99	1.40	1.13	1 59	1.70	2.70	.....	5.13	2.30
	3	2.20	4.11	1.87	2.26	2.02	1.64	1.24	3.20	1.84	1.50	4.00	1.25	1.58	.....	0.95	4.79	1.43	5.78	2.28	1.64	0.76	2.43	1.75	2 07	4.63	4 41	1.72	3.10	2.94
Lower lug cracked. Fig. 11.	1	0 06	.....	.....	0.21	0.36	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.12	.....	0.02	.....	.....	.....	0.47	.....	1.01	.....	.....	.....	.....
	2	0.01	.....	.....	.....	.....	.....	.....	.....	0.07	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	3	0.03	.....	.....	0.10	0 18	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.07	.....	0.01	.....	.....	.....	0 30	.....	0.74	.....	.....	.....	.....
Both lugs off. Fig. 12.	1	2.33	.....	1.33	2.58	2.32	.....	0.90	1.78	2 47	2.40	.....	1.42	2.52	.....	1.88	1.96	1.51	4.45	2.96	2.36	0.89	3.14	3 62	3.52	.....	1.01	1.01	1.96	2.08
	2	1 04	1.45	1.18	1.96	0.87	.....	0.19	.....	0.40	4.25	.....	0.89	.....	.....	1.43	0.96	0.68	0 81	4.32	1.35	0.88	1.40	0 85	.....	.....	.....	.....	1.28	0.82
	3	1.61	0.91	1.25	2.26	1.58	.....	0.48	1.16	0.97	3.38	.....	1.08	1.98	.....	1.58	1.60	1.07	3.01	3.68	1.82	0.89	2.11	2.06	2.21	.....	0.74	0.62	1.55	1 04
Head off at neck. Fig. 16.	1	2.57	2.47	1.33	3.61	1.96	.....	1.35	12.45	1.76	2.40	.....	0.79	1 91	.....	1.41	1.09	0.76	2.69	2.96	3.02	0.89	2 99	1.81	1.88	8.17	2.02	1.55	5.88	2.08
	2	2.18	.....	1.18	5.61	1.22	.....	0.12	2.52	3.14	3.55	1.64	1.78	1 82	2.22	0.95	2.30	1.35	0.54	1.66	3.06	0.74	.....	1.41	1.19	5.08	.....	1.03	14.10	3.12
	3	2.35	0.91	1.25	4.06	1.58	.....	0.62	9.01	2.76	3.01	1.33	1.42	1.19	2.22	1.10	1.53	1.07	1.84	2 28	3.04	0.79	1.22	1 9	1.62	6.48	1.47	1.38	10.85	2.94
Barrel off at shoulder. Fig. 17.	1	6.25	7.41	2.67	10.85	6 24	6.06	3.60	4.00	10.76	2.40	7.14	4.74	3.03	.....	3.75	8.27	3 03	4.51	2.96	6.31	2.03	5.98	4.71	19.25	20 40	9.00	8.81	13.72	7.03
	2	2.11	4.34	.....	2.53	1.56	.....	0.43	0.84	3.87	2.13	.....	1 69	1.82	1.45	0.95	4.22	1.35	3.21	0.67	2.20	1.03	.....	0.85	1.76	1.70	2.70	2.06	8 97	3.23
	3	3.94	5.48	1.25	6.48	3.87	3.28	1.72	2.91	5.77	2.26	1 33	2.79	2.77	4.45	1.89	6 80	2.11	4.01	1.75	4.11	1.40	2 43	2.54	13 86	10.18	7.35	6.55	10.85	3.90
Draft bolt pulled through. Fig. 18.	1	3.08	.....	1.33	0.62	1.07	.....	0.27	0.22	9.00	1.60	7.14	0.95	0 51	.....	2.35	2.29	2.27	13.06	.....	1.75	0.65	4.40	6.16	2.11	2.04	5.65	4.66	1 90	2.60
	2	1.96	1.45	.....	0.09	1.74	3.57	.....	.....	2.27	0.71	1.64	0.89	5.46	3.70	0 24	1.72	0.68	19.6	.....	0.62	0 93	2.48	2.26	0.79	.....	2.70	6.39	.....	0.71
	3	2.46	0 91	0.63	0.34	1.41	1.64	0.11	0.14	4.12	1.13	2.67	0.91	1.58	3.70	0.95	2.08	1.43	15.64	.....	1.13	0.82	3.26	3.97	1.62	0.93	4.41	5.17	0.78	1.04
Burnt.	1	0.05	.....	.....	.....	.....	.....	.....	.....	0.71	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.08	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	3	0.02	.....	.....	.....	.....	.....	.....	.....	0.19	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.04	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Worn out.	1	0.07	.....	.....	0.41	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.12	0.08	0 16	.....	.....	.....	.....	.....	.....	.....	.....
	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	3	0.03	.....	.....	0.20	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.06	0.03	0.06	.....	.....	.....	.....	.....	.....	.....	.....
No defects observed.	1	0 58	.....	.....	0.21	.....	.....	.....	.....	1.23	.....	.....	0.16	.....	.....	.....	.....	.....	0.41	.....	1.08	0.16	0.31	.....	5.40	.....	.....	.....	.....	.....	.....
	2	0.02	0.73	.....	0.19	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.09	.....	.....	.....	.....	.....	0.40	.....	.....	.....	.....	.....	.....
	3	0.27	0 46	.....	0.20	.....	.....	.....	.....	0.34	.....	.....	0.06	.....	.....	.....	.....	.....	0.9	.....	0.48	0.08	0.13	.....	3.54	.....	.....	.....	.....	.....	.....
Miscellaneous.	1	1.50	2.47	1.33	0.83	0.89	.....	0.63	2.44	1.06	2.40	.....	2.37	2.52	.....	1.41	2.72	3 79	1.41	1 48	1.23	1.62	0.94	0.36	1.88	2.04	2.92	3.63	7.85	2.34
	2	0.79	0.73	3.72	0.56	1.39	.....	0.19	0.84	1 40	0.71	.....	0.71	1.82	.....	1.43	1.15	2.03	1.44	1.65	0.55	0.83	0.22	.....	1.98	.....	5.41	.....	6.41	0.55
	3	1.09	1.37	2.50	0.69	1.14	.....	0.37	1.89	1.31	1.50	.....	1.31	2.37	.....	1.42	2.15	2.86	2.43	1.58	0 87	1.13	0.51	0.16	1 92	0.93	2.94	2.41	6.98	0 86
Totals.		100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

SUMMARY OF THE ABOVE BY MAIN CLASSES OF FRACTURES.

Total arm fractures.	1	64.08	67.89	76.01	67.04	67.91	81 82	83.09	67.11	60.96	69.60	50.00	70.46	67.17	.....	79.34	54.62	48.49	33.81	80.00	70.36	72.45	60.06	69 93	44.59	51.02	86.36	55.44	56.86	55.21
	2	79.64	67.38	81.17	81.85	83 85	96.42	94.93	90.34	83.37	68.80	81.96	85.17	67.27	81.49	81.70	77.78	83.77	43.97	80.73	79.59	82.10	80.91	81.92	78.18	81.35	75.68	78.35	57.70	75.95
	3	72.78	67.58	78.75	74.81	75.99	88.52	90.13	75.15	77.13	68.80	76.09	79.87	67.19	81.49	80.92	63.01	67.14	37.84	80.38	75.31	78.47	72.43	76.66	57.08	67.59	47.06	63.12	57.36	72.34
Total face and back fractures.	1	11.80	12.35	8.00	5.79	13.90	6.06	6.65	4.44	6.17	11.20	14.29	14.85	19.70	.....	4.70	29.99	35.61	28.10	2.59	6.34	13.29	12.11	3 98	13.15	4.08	37.38	20.72	3.92	13.55
	2	5.28	7.98	2.36	2 06	5.03	.....	2.13	1.68	2.81	4.26	6.55	6.27	16.36	6.66	5.70	7.28	4.73	17.54	1.66	4.32	6.57	4.31	3.95	4.76	3.40	2.70	9.28	1.28	6.57
	3	8.16	9.60	5.00	3.83	8.41	3.28	3.91	3.49	3.73	7.52	8.00	9.38	18.97	6.63	5.39	16.03	19.29	23.93	2.10	5.25	9.11	7.49	3.97	10.62	3.71	27.94	16.89	2.33	7.79
Total lug fractures.	1	10.02	7.41	9.33	10.64	8.03	6.06	4.41	9.34	8.65	10.40	21.43	5.68	6.06	.....	7.04	10.02	6.05	15.98	10.01	9.78	8.83	13.05	13.05	10.80	12.25	8.06	5.19	9.81	17.19
	2	8.02	17.39	11.77	7.11	5.21	.....	2.28	8.65	3.14	20.56	8.20	3.46	5.45	1.48	9.03	3.83	6.09	13.58	13.62	9 66	7.80	12.98	9.61	7.94	8.47	10.81	3.09	11.54	9.87
	3	8.90	15.69	10.62	8.79	6.60	3.28	3.14	4.65	4.65	15.78	10.67	4.26	5.93	1.48	8.36	8.40	6.07	15.03	11.91	9.71	8.19	12.47	11.11	9.74	10.18	8.83	4.48	10.85	11.13
Total barrel fractures.	1	11.90	9 88	5.33	15.08	9.27	6.06	5.22	16.67	21.52	6.40	14.28	6.48	4.55	.....	7.51	11.65	6.06	20.26	5.9	11.06	3.57	13.37	12.68	23.24	30.61	16.16	15.02	21.56	11.71
	2	6.25	5.79	1.18	8.23	4.52	3.57	0.55	3.36	10.28	6.39	3.28	4.36	9.10	10.37	2.14	8.24	3.38	23.38	2.33	5.88	2.70	2.48	4.52	6.74	6.78	5.40	9.28	23.07	7.06
	3	8 75	7.30	3.13	11.42	6.86	4.92	2.45	12.06	12.65	6.40	5.33	5.12	5.54	10.37	3.91	10.41	4.64	21.49	4.03	8.28	3.01	6.91	8.10	17.10	17.59	13.23	13.10	22.48	7.88
Miscellaneous.	1	2 20	2.47	1.33	1.45	0.89	.....	0.63	2.44	3.00	2.40	.....	2.53	2.52	.....	1.41	2.72	3.79	1.82	1.48	2.34	1.86	1.41	0.36	7.28	2.04	2.02	3.63	7.85	2.34
	2	0.81	1.46	3.52	0.75	1.39	.....	0.19	0.84	1.40	0.71	.....	0.71	1.82	.....	1.43	1.15	2.03	1.53	1.66	0.55	0.83	0.22	.....	2.38	.....	5.41	.....	6.41	0.55
	3	1 41	1.83	2 50	1.09	1.14	.....	0.37	1.89	1.84	1.50	.....	1.37	2.37	.....	1.42	2.15	2.86	1.71	1.58	1.45	1.22	0.70	0.16	5.46	0.93	2.94	2.41	6.98	0.86
Total.		100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

Relative Frequency of Breakages in Different Parts of Wrought Iron Janney Freight Coupler Knuckles. Determine by Percentage Computations from the Total Number of Breakages Reported by each Railroad from Jan. 1, 1888, to March 31, 1893.
(Period No. 1 is from Jan. 1, 1888, to March 31, 1892. Period No. 2 is from April 1, 1892, to March 31, 1893. Period No. 3 is from Jan. 1, 1890, to March 31, 1893.)

Nature of defect.	Period.	Gen. Ave.	Ally Vall	Balt. & Ohio.	C., B. & Q.	C., C., C. & St. L.	Canda C. C. Co.	Chic. Milw. & St. P.	Chic. & N. W.	Chic. R. I. & Pac.	Ches. & Ohio.	Grd Rap. & Ind.	Lake Shore & M. S.	Lehi. Vall.	Mo. Pac.	No'n Cen.	N. Y. Cen. & H. R.	N. Y. Chic. & St. L.	N. Y. L. E. & W'n.	No'n Pac.	Pa. R. R.	Pa. Co. N. W.	Phil. & Vll. & Balt	Rich & Dan.	R'mo. Wat. & Og.	U'n Pac.	West Shore.	W'n N. Y. & Pa.	Wis. Cen.	Misc.
		%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
Upper lug off. Fig. 1	1.	27.59	13.15	16.53	27.85	21.09	14.59	26.78	30.73	25.40	19.63	32.94	17.30	10.26	22.01	24.85	11.49	12.31	20.13	31.02	38.56	32.01	36.83	21.49	17.10	36.67	19.18	13.92	37.58	27.98
	2.	25.56	17.85	6.89	23.92	16.02	10.11	32.33	30.30	15.76	15.36	32.94	17.10	20.94	9.93	27.64	15.76	14.33	15.64	21.71	37.11	36.76	39.46	24.71	18.14	18.64	15.00	8.82	27.76	25.09
	3.	23.71	14.85	10.85	23.12	19.34	12.44	34.46	30.90	28.85	17.83	33.74	13.90	21.05	13.07	27.41	13.68	16.05	15.87	24.10	37.21	30.89	31.74	22.54	17.40	28.89	17.12	11.84	31.83	22.13
Upper lug cracked. Fig. 2	1.	13.98	27.61	15.70	7.57	19.3	20.81	8.28	9.48	8.42	17.58	8.83	33.01	31.15	16.91	27.41	33.01	35.04	32.33	22.31	13.58	22.35	20.89	17.81	11.94	9.79	17.12	9.84	9.98	22.38
	2.	22.10	29.05	14.58	7.82	8.22	27.11	18.38	10.63	11.62	13.33	11.47	41.86	36.01	29.61	24.15	35.93	41.13	31.65	7.21	18.36	25.25	11.44	17.61	11.86	8.59	31.00	22.60	8.64	22.40
	3.	19.85	29.82	31.40	9.75	26.76	43.75	16.12	21.09	23.88	13.93	13.21	21.31	18.48	38.68	14.29	25.30	23.61	19.36	23.35	15.81	17.50	21.67	31.28	28.91	6.67	26.50	21.65	8.51	18.53
Upper lug chipped. Fig. 3	1.	16.91	27.46	9.19	9.11	23.58	32.81	23.81	26.82	27.50	12.85	25.75	12.82	12.84	21.65	31.02	18.27	18.61	22.51	23.95	11.00	14.97	20.17	31.79	24.08	23.38	16.25	16.25	16.7	18.78
	2.	18.58	26.96	18.90	9.90	26.96	48.11	19.97	29.17	26.02	13.48	22.13	17.86	17.55	28.73	27.16	23.37	21.89	20.70	23.63	13.28	16.75	24.06	32.76	28.94	15.13	21.68	25.31	18.18	15.36
	3.	5.29	3.26	5.79	7.59	4.85	2.06	13.52	11.18	6.01	2.71	8.83	3.70	5.98	7.79	5.46	4.63	2.13	5.75	3.78	4.20	3.83	5.22	3.77	10.52	6.67	7.53	3.22	9.58	5.61
Lower lug off. Fig. 4	1.	5.14	2.74	0.58	2.19	5.02	13.40	9.54	6.63	5.33	4.79	2.48	1.83	3.44	3.41	5.51	1.79	4.33	6.94	3.52	4.33	5.69	4.74	3.98	10.37	11.09	10.00	2.97	6.35	5.86
	2.	5.94	3.97	2.13	7.69	4.94	3.79	13.67	10.87	6.58	3.83	5.93	3.20	5.30	4.34	4.88	2.01	5.13	5.22	3.87	4.55	4.53	5.64	3.63	9.21	8.41	7.73	3.17	7.66	6.07
	3.	2.95	5.83	4.13	3.59	3.04	1.04	2.35	1.75	1.60	2.91	4.76	3.80	2.32	3.09	2.31	4.96	6.20	3.02	1.54	1.62	2.67	2.64	2.36	3.55	1.33	7.66	1.33	1.50	4.24
Lower lug cracked. Fig. 5	1.	2.65	1.35	1.35	2.39	3.04	2.03	2.14	1.96	1.62	1.25	2.99	4.16	5.05	2.91	4.78	3.12	2.15	3.25	1.06	1.62	2.67	2.24	1.98	2.67	1.30	10.00	2.97	1.50	2.71
	2.	2.61	4.82	3.31	1.91	2.92	2.78	2.93	2.73	1.62	1.60	4.01	4.65	4.45	2.75	4.01	2.71	2.71	3.12	0.67	1.56	2.67	2.61	1.97	3.95	1.31	5.31	6.40	3.47	1.36
Lower lug chipped. Fig. 6	1.	1.68	1.14	1.14	1.06	2.39	4.67	1.45	2.73	2.63	0.63	4.61	1.69	2.75	4.01	8.24	2.91	2.71	2.59	0.84	0.75	1.25	1.67	0.55	3.95	2.60	6.85	3.47	1.06	1.78
	2.	1.93	3.49	2.05	1.33	2.74	3.24	1.70	2.78	2.63	1.19	2.13	1.65	4.01	2.83	5.88	3.02	2.59	2.64	2.86	1.37	1.84	2.33	2.77	3.95	2.60	5.76	3.25	1.39	1.36
	3.	8.01	6.12	1.14	7.62	5.93	5.21	9.49	6.82	7.40	5.02	5.88	4.62	5.53	4.85	4.61	4.16	5.02	7.82	5.02	19.81	13.60	7.40	3.72	13.16	21.93	6.15	15.96	7.49	7.49
Both lugs off. Fig. 7	1.	7.91	5.72	0.68	7.29	5.41	2.70	6.82	8.20	7.78	4.49	11.49	3.73	5.45	4.73	4.49	4.14	3.33	3.85	2.10	21.05	13.41	8.94	5.65	13.16	17.77	6.64	4.32	17.73	7.57
	2.	7.98	5.98	0.26	5.41	5.52	1.04	0.21	0.21	0.10	0.44	0.34	0.09	0.46	0.77	0.41	0.25	0.97	0.33	0.71	0.53	0.16	0.43	0.23	0.79	0.27	0.40	0.15	0.24	0.40
	3.	0.12	0.23	0.12	0.27	0.10	0.54	0.11	0.17	0.24	0.10	0.21	0.10	0.15	0.91	0.10	0.19	0.63	0.17	0.62	0.10	0.06	0.09	0.50	0.36	0.27	0.69	0.24	2.32	0.15
Both lugs cracked. Fig. 8	1.	3.5	2.60	1.78	6.32	3.13	3.24	2.71	3.09	8.72	4.41	4.15	1.45	2.70	4.24	2.12	0.96	6.01	4.26	4.21	1.90	2.37	4.24	6.04	5.36	2.67	10.96	5.17	3.19	2.32
	2.	2.64	2.34	0.58	1.89	3.57	3.24	2.76	3.11	6.11	4.30	9.04	4.65	1.92	1.72	1.46	1.13	1.07	1.65	4.21	0.73	1.18	4.19	2.16	5.36	3.29	7.46	2.16	1.59	1.39
Both lugs chipped. Fig. 9	3.	2.64	2.39	1.65	4.73	2.74	1.61	2.92	2.63	2.85	1.45	2.38	2.90	1.36	2.18	1.42	0.39	4.26	3.16	4.11	1.24	1.91	3.46	5.50	5.36	3.29	7.46	4.02	3.19	1.69
	1.	0.51	0.98	0.51	0.86	0.70	0.74	0.45	0.69	0.23	0.63	0.42	0.25	0.63	0.38	0.63	0.72	0.39	0.35	0.91	1.18	2.13	0.69	0.15	1.83	0.69	1.83	0.06	0.69	0.60
Upper lug off, lower cracked. Fig. 10	2.	0.41	0.46	0.46	0.70	0.89	0.55	0.69	0.21	0.87	0.40	0.42	0.10	0.15	0.41	0.59	0.24	0.77	0.27	0.47	0.10	0.06	0.09	0.55	0.47	0.39	1.83	0.13	0.39	0.33
	3.	0.82	0.98	0.38	0.49	0.34	0.59	0.21	0.51	0.25	0.59	0.21	0.10	0.24	0.59	0.24	0.12	0.39	0.17	0.24	0.12	0.06	0.09	0.51	0.24	0.27	0.69	0.24	0.94	0.24
Lower lug off, upper cracked. Fig. 11	1.	0.97	0.95	0.95	0.41	0.54	1.04	0.54	0.38	0.36	0.17	0.34	0.15	0.98	0.15	0.36	0.14	0.33	0.13	0.31	0.10	0.06	0.09	0.45	0.39	0.27	0.69	0.24	0.94	0.24
	2.	2.19	2.05	1.83	1.83	1.83	1.04	1.12	2.55	2.63	0.91	2.55	0.40	1.54	1.83	1.69	0.87	0.77	3.10	1.99	0.53	1.68	2.01	0.75	1.09	1.76	1.92	2.87	1.52	3.19	1.81	3.17	1.75
Upper lug off, lower chipped. Fig. 12	3.	1.80	1.99	0.34	1.70	1.61	1.06	2.36	2.24	2.84	1.06	1.28	1.42	1.59	0.91	1.52	0.88	3.25	2.31	1.99	4.01	1.85	2.36	1.91	1.92	2.63	2.63	1.39	2.13	2.50
	1.	1.63	0.83	0.83	2.95	2.92	2.08	3.05	4.25	5.86	2.25	4.41	1.90	1.97	2.32	2.10	0.73	2.31	1.99	1.42	5.26	0.97	1.11	2.46	1.92	2.79	5.33	2.13	5.55	1.78
Lower lug off, upper chipped. Fig. 13	2.	1.47	0.69	0.34	2.00	2.16	1.03	4.00	2.73	4.10	1.32	0.46	1.42	1.13	1.03	1.04	0.65	0.36	1.04	1.65	1.75	4.66	1.31	1.84	1.92	6.38	1.69	0.24	5.32	2.05
	3.	1.94	1.16	0.34	2.16	2.23	1.03	3.85	3.97	4.10	1.70	2.94	0.79	1.44	2.12	1.80	0.46	0.30	2.61	1.63	1.18	1.07	1.84	1.81	1.92	1.30	0.24	0.24	0.76	0.76
	1.	0.77	0.39	0.39	0.70	0.52	1.01	0.59	2.87	1.32	0.46	2.94	0.79	0.36	0.43	0.69	0.25	0.43	0.19	1.07	0.74	0.79	0.45	1.43	1.92	0.30	0.24	0.24	0.40	0.24
Tail off. Fig. 14	2.	0.69	0.69	0.69	0.61	0.10	0.54	0.47	2.50	0.91	0.63	0.85	0.45	0.28	0.63	0.60	0.33	0.63	0.33	0.82	0.77	0.82	0.77	1.71	1.92	0.30	0.24	0.24	0.40	0.24
	3.	0.96	0.96	0.96	0.67	0.38	0.77	0.77	1.10	0.96	0.77	1.47	0.58	0.77	0.72	0.77	0.58	0.77	1.12	0.77	0.77	0.77	1.07	2.75	1.92	0.77	0.77	0.77	0.77	0.77
Worn out	1.	6.95	6.95	6.95	6.95	6.95	6.95	6.95	6.95	6.95	6.95	6.95	6.95	6.95	6.95	6.95	6.95	6.95	6.95	6.95	6.95	6.95	6.95	6.95	6.95	6.95	6.95	6.95	6.95	6.95
	2.	4.85	0.33	44.07	31.02	0.89	1.03	1.06	0.08	0.51	30.25	0.42	0.89	0.61	2.73	0.84	0.33	1.78	1.89	0.77	0.89	0.99	1.13	1.91	1.65	0.27	0.44	0.27	16.10	0.85
	3.	2.31	0.69	0.34	2.95	2.92	2.08	3.05	4.25	5.86	2.25	4.41	1.90	1.97	2.32	2.10	0.73	2.31	1.99	1.42	5.26	0.97	1.11	2.46	1.92	2.79	5.33	2.13	5.55	1.78
No defects observed	1.	0.57	0.26	0.26	0.34	0.16	0.08	0.11	0.11	0.37	0.68	0.42	0.96	0.61	0.30	0.84	0.26	1.16	0.53	0.30	0.34	0.30	0.34	0.30	0.30	1.83	0.65	0.27	0.85	0.35
	2.	1.74	5.72	0.38	0.99	0.41	0.08	0.09	0.21	1.27	1.88	0.84	0.89	0.21	0.09	2.19	0.38	0.68	0.62	0.75	4.22	2.81	0.62	0.25	0.25	0.65	3.74	0.27	0.35	0.62
	3.	1.08	3.40	0.31	0.24	0.24	0.08	0.09	0.09	0.91	0.91	0.24	0.89	0.07	0.18	1.89	0.24	0.62	0.39	0.24	0.62	0.24	0.39	0.24	0.39	1.33	1.33	0.12	0.35	0.36
Miscellaneous	1.	0.07			0.32	0.16	0.06			0.07	0.48	0.21	0.21	0.07	0.42	0.42	0.23	0.39	0.15	0.47	0.62	0.31	0.19	0.68	1.32	0.66		0.27	0.13	0.04
	2.	0.24			0.20	0.10	0.04			0.03	3.17		0.14	0.07		1.13	0.48	0.25	0.10	0.23	0.27	0.38	0.27	0.48	1.32	0.66		0.15	0.13	
	3.																													
Total		100.0	100.0	100.00	100.00	100.00	100.0	100.0	100.00	100.00	100.00	100.00	100.0	100.00	100.00	100.0	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

the operation of shutting or opening the draw occupies 5 minutes; we are indebted to "Industries" for the material from which the above is condensed.

A NEW FLEXIBLE JOINT FOR WATER PIPE.

We illustrate herewith a ball-and-socket joint designed for use on water mains which have to be laid under water. Its production is the result of extensive experience by the inventor, who is a contractor of extensive experience in submarine work, with the ordinary forms of flexible joints.

In this joint there is no boring of hollow spherical surfaces. The ball on the spigot end of the pipe is turned spherical, and the collar which goes over it is finished to a slight taper. The collar is then placed in position on the ball, a ring of clay is put around their junction at the bottom, and the space between the collar and the ball is run full of lead.

A New Form of Ball and Socket Joint.

The mouth of the hub is turned to a taper to fit the taper on the collar, and the pipe is ready to be joined up. When this is done the two taper surfaces coming together make a tight fit against each other and compress the collar and its lead lining, thus making the ball tight in its socket. This joint is guaranteed to stand heavy pressures without injury. In our illustration (which was made from a small model) screws are shown at the joints, but in actual practice bolts are of course used. The inventor of this joint, Mr. Jos. G. Falcon, of Evanston, Ill., has recently contracted to lay 900 ft. of pipe fitted with this joint at Fort Sheridan, Ill., forming the intake for the water-works. This pipe will replace an equal length of spiral welded wrought iron pipe, which was wrecked last spring by the ice.

CONCERNING THE FUTURE TIMBER SUPPLY IN THE UNITED STATES.

In a circular letter lately issued by the United States Department of Agriculture, Mr. B. E. Fernow, Chief of the Forestry Division, criticises a letter published by Mr. Henry Gannett, Chief Geographer of the U. S. Geological Survey. In this letter Mr. Gannett undertakes to show that the present efforts to bring about a more conservative and rational forest policy in the United States are unnecessary; because the relations of forest growth to climatic, soil and water conditions are of no practical significance, and because the timber growth is renewing itself faster than it is consumed. Mr. Gannett says that the wooded area of the United States is approximately 1,113,000 sq. miles, or 712,320,000 acres, and that each acre produces 40 cu. ft. of wood annually. On this assumption and with an annual consumption of from 20 to 24 billion cu. ft., there would be an over-production of from 6 to 10 billion cu. ft. each year.

Mr. Fernow first calls attention to the fact that Mr. Gannett has become more conservative in his estimate of forest area and drops from 50 to 37% of the total area regarded as wooded. The Forestry Division, as the result of more careful examination, figures the total forest area at 500,000,000

acres. Mr. Gannett has certainly included several million acres of waste brush land in his estimate of wooded territory; lands producing nothing of value as timber. Then Mr. Fernow attacks his estimate of 40 cu. ft. annual growth per acre, in figuring upon the kind of wood which enters into an estimate of annual wood consumption. The Chief of the Forestry Division discusses this question as follows:

In the well-managed forests of Prussia (some 35,000,000 acres), largely stocked on poor land, the average total production of wood per acre for a long series of years has not been more than 21 cu. ft., but this includes branch wood, brush and roots, which are not used in our country. Of this only 14%, or hardly 3 cu. ft., represent material fit for the industrial uses; and we should add, in the United States firewood is also made from such material. In the government forests of Prussia (some 8,000,000 acres), exemplary in their management, the production reaches nearly 6 cu. ft. The highest wood production in German forests is reported from Baden (over only 4,330,000 acres of forest), with somewhat over 50 cu. ft. of wood per acre per year. Assuming, also, a larger per cent. of sizeable timber, namely 20%, we would here find the annual production per acre of such material as we are in the habit of using at the rate of 10 cu. ft. per acre. Competent writers on the subject, who believe that the government reports understated the annual growth, have calculated the same to be as high as 55 cu. ft. per acre (see report of Forestry Division, 1886, p. 184), of which they assume 27% to represent wood over 3 ins. in diameter; even this larger figure would bring the product of sizeable wood to less than 15 cu. ft. per year. And I repeat what is well known, that in the United States we hardly use the smaller sizes even for firewood.

To come now to more familiar measurements, we can figure out the possibilities or probabilities in the following manner, leaning toward extravagance rather than conservatism: Any lumberman acquainted with the various forest regions of the United States will admit that, leaving out the exceptional conditions on the Pacific coast, a cut of 20,000 ft. (board measure) per acre from our virgin forests would be an absurdly large average estimate; this would represent, with excellent practice in the preparation of the material, say, 2,000 cu. ft. of round forest-grown timber, and since the trees cut to yield such material are at least 150 years old—they are, in reality, mostly over 200 years—the annual production would appear under such conditions as 14 cu. ft. per acre per annum, or about as much as the most advantageous results reported from well-managed German forests.

Apply this most extravagant figure to the area as given by Mr. Gannett, and we find that our consumption is at present from 10 billion to 14 billion cubic feet in excess of what the area could possibly produce as an annual crop; or that we are cutting into our capital to the extent of more than 50% of our consumption, and not, as Mr. Gannett would have it, that we are laying up for the future, which, by the way, increases the demands for wood material at the rate of more than 35% every decade.

REVOLUTION IN ELECTRIC HEATING.*

Mr. Frank H. Mason, U. S. Consul at Frankfort, reports the following seemingly very important discovery in electric heating: The invention is the joint achievement of two Belgian scientists—Messrs. Lagrange and Hobo—who, a few days ago, applied to the imperial German patent office for patents on a new method of heating, melting and refining metals by means of electrical heat.

The apparatus consists of a glass or porcelain vase, which may be of any size conveniently adapted to the purpose, provided with a lining of lead connected with a strong conductor of positive electricity. The vase is filled to three-fourths its capacity with acidified water. A pair of iron tongs with insulated handles is attached by a flexible conductor to the negative pole of an electrical current generated by an ordinary dynamo. With this simple and inexpensive equipment the following phenomenon is produced:

The electrical current having been switched on, a bar of wrought iron or other metal is taken up with the tongs and plunged into the water within the vase. Immediately the water begins to boil at the point of contact; the immersed portion of the iron rises quickly to a red, then to a white, heat, and emits a stream of brilliant white light. In a few moments the heat becomes so intense that the iron melts and falls off in bubbles and sparks, leaving a clear, glowing surface in perfect condition for welding. The heating process has been so rapid that neither the water nor the end of the bar held within the tongs have been more than slightly warmed, and, the current being switched off, the bar, with its submerged end glowing, may be readily held in the naked hand. If, instead of a bar of metal, a stick of carbon is used, the heat in a few minutes produces detached fragments of amorphous carbon, which proves scientifically that a temperature of 4,000° Celsius has been developed. The rapidity of the heating and the limit of temperature to be reached are easily and accurately governed by the strength of the current employed, so that the whole process is under the absolute control of the operator. During the recent experiments at Berlin the measuring instruments registered a tension of 120 volts and an energy of 220 amperes. It was estimated that fully 50% of the current was directly utilized as heat, whereas the practical limit of such utility has not hitherto exceeded 20%. It is stated by the inventors that by employing a still stronger current a temperature of 8,000° Celsius has been developed. The mechanical importance of this fact will be apparent when it is remembered that this is a degree of heat nearly three times greater than that required to extract iron from the ores, the most refractory of which fuse at about 2,700°.

Divested of all merely technical phraseology and reduced to its simplest terms, the process under consideration may be explained as follows: One of the well known effects of electricity is to separate compound fluid bodies through which it passes into their primitive elements. The current, passing through the tongs and metallic bar into the water, decomposes the latter into its two gaseous elements—oxygen and hydrogen. The oxygen is attracted and gathered on the relatively large surface of the lead lining and produces no noticeable effect. The hydrogen, on the other hand, gathers around the immersed portion of the bar; and, as this has a comparatively limited surface area, it is immediately surrounded with a close envelope or jacket of hydrogen, which, being a bad conductor of electricity, creates a powerful resistance to the passage of the current and thus develops the heat which causes the bar to glow and melt. It is merely an application of the well known law that friction or resistance to the passage of an electrical current causes heat, and the apparent paradox of a piece of cold metal plunged into cold water rising rapidly to a melting glow is as simply and clearly explained as the incandescence of a platinum coil in a vacuum bulb.

For welding purposes, the new process is pronounced perfect. The clean envelope of hydrogen which surrounds the heated metal prevents oxidation, and the welding surface is left free from the effects of sulphur and other impurities, which are always present when iron is heated by a coal fire in an ordinary forge. The quality which entails the largest possibilities, and which has been as yet only superficially investigated, is the capacity of this process to heat quickly and to any desired temperature the end or submerged surface of a mass of iron while the remainder of the mass is left cool and comparatively unaffected by the heat. It is believed that this may lead to important results in the hardening and tempering of armor plates and other objects in iron and soft steel in which great resistance to penetration or abrasion by friction is requisite, while preserving the interior tough and fibrous to resist concussion or strain, as in many parts of machinery. At Essen, Messrs. Krupp & Co. are experimenting with it in the hardening of steel cannon; and it is believed that in chemistry this method of producing an intense and easily regulated temperature may lead to the successful manufacture of diamonds, rubies, and sapphires through the production of the larger forms of crystallized carbon.

Whether it is applicable as an electrolytic process to the reduction of metals seems to be disputed. One account claims that by it the cost of refining gold, platinum, copper, nickel, and even iron will be reduced 80%, while other authorities assert that, though metallic oxides may be successfully reduced by this method, no other foreign substances contained in the metal will be eliminated by it. In any event, however, the discovery of the principle that has been already demonstrated must open a wide and interesting field of research to the electricians of all countries.

*From advance sheets of consular reports, June, 1893.

RAILWAY IMPROVEMENTS FOR THE WORLD'S COLUMBIAN EXPOSITION TRAFFIC.—III.

Northern Pacific R. R.—Mr. Wm. S. Mellen, General Manager, writes us that this company has been improving its line materially for some years by replacing wooden trestles and bridges with permanent iron, stone and earth structures. The equipment also, in locomotives and passenger and freight cars, has also been constantly improved for several years, by the application of improved devices, such as air brakes, automatic couplers, air signals, vestibules, etc. No special preparations have been made for the World's Columbian Exposition business, except to get the locomotive and passenger car equipment in first-class order during the winter months, so that none of it would be out of service in shops for repairs during the season of Exposition traffic. The company has an exhibit in the Transportation Building, consisting of two cars specially constructed for the purpose, in which its Land Department has arranged a very complete exhibit of the mineral, forest and agricultural products of the country through which the Northern Pacific R. R. runs. The property under Mr. Mellen's charge lies west of St. Paul, Minn., and Ashland, Wis., and does not extend to Chicago. The running of trains by the Northern Pacific R. R. into the Exposition grounds is under the management of Mr. S. R. Ainslie, General Manager of the Wisconsin Central lines (Northern Pacific R. R., lessee).

Chicago & Northern Pacific R. R.—We learn from Mr. S. R. Ainslie, General Manager, that aside from painting the Grand Central passenger station, at the corner of Fifth Ave. and Harrison St., Chicago, the company will make no alterations. This terminal station is complete in every respect, and will furnish ample facilities for all the business of the various tenants of the property, but the company has, however, fitted up 100 first-class rooms in the building for hotel purposes, which will be reserved for patrons of the various railway lines using the building, including the Baltimore & Ohio, the Chicago & Great Western and the Northern Pacific railways. This road will run frequent suburban passenger trains, not only from the West Side, but from the Grand Central station to the Exposition, using the Baltimore & Ohio R. R. tracks from Seventy-fifth St. to the Exposition grounds. For the increased traffic 8 new passenger engines, 20 passenger cars and 50 special cars for the excursion traffic have been provided. The Baltimore & Ohio R. R. has in addition to this built an equal number in case the demand should require it. These cars are illustrated and described in another column. The cost of extra equipment will aggregate $198,000. The line being practically new and equipped with the latest interlocking and blocking devices, no additional expense has been incurred on account of the Exposition business. There is no reliable information available relative to the number of passengers which will be carried. The road has direct access to the Exposition, and trains will run inside the grounds. The only exhibit made by the Chicago & Northern Pacific R. R. Co. is one new suburban engine. Attention is called to the fact that this road is entirely separate from the Northern Pacific R. R. Co. proper, which has a special exhibit and has incurred more or less expense in providing facilities for its Exposition business, as noted above.

Baltimore & Ohio R. R.—This road has made preparations for a heavy through traffic, and part of this traffic will be sent over the Pittsburg & Western R. R., which the Baltimore & Ohio R. R. Co. purchased about two years ago, and has since spent a large amount of money upon it, double-tracking, reducing grades, etc. The number of locomotives added for Exposition traffic is 100; passenger cars added, 50; Pullman sleeping cars will be added as needed. The road has 250 miles equipped with block signals as part of the improvements to the track, and extensions have been made to double-track and additional side tracks put in at meeting points, making an addition of about 50 miles of track at an expenditure of $1,000,000. The cost of the additional equipment is about $1,200,000. Arrangements for additional facilities at Chicago terminals have been made by the construction of about a mile of track (as shown on the map in an issue of Jan. 16, 1892), so that the company can run trains to the Exposition grounds on its own tracks. Double sections of regular trains will be run, as well as such special trains as the business warrants. Excursion trains will run into the terminal station in the Exposition grounds. Annex or local trains will also meet all the eastbound and westbound trains at South Chicago, and carry passengers to the station at Seventy-first St., or direct to the Exposition grounds. We are indebted to Mr. J. T. Odell, General Manager, and Mr. Charles O. Scull, General Passenger Agent, for the above particulars.

Grand Trunk Ry.—In reply to enquiries as to additions to equipment, etc., for the Exposition traffic, Mr. L. J. Seargeant, General Manager, states that this company is not in a position to take any special credit for enterprise in connection with the Exposition. It has been made a special object to work the company's rolling stock up to a standard of more than the ordinary excellence, but no locomotives or cars have been built upon that particular account. While the company has contributed,

through other companies and through its Chicago connection, to enhance certain exhibits, no exhibit of a striking character has been prepared expressly on this company's account. The Grand Trunk Ry. through passenger train arrangements have been increased by additional through trains in connection with the New York, Ontario & Western Ry., Philadelphia & Reading R. R. and Lehigh Valley R. R. Several of the company's express trains have been accelerated, additional Pullman sleeping, parlor, vestibule and buffet cars have been provided, and the company's trains will be run into the Exposition grounds (Jackson Park) over the tracks of the Illinois Central R. R.

Chicago & Grand Trunk Ry.—This road has bought 100 first-class cars; 60 of these are for the Grand Trunk Ry. proper in Canada, and the remaining 40 are for the Chicago & Grand Trunk Ry. between Chicago, Port Huron and Detroit. The latter division of the Grand Trunk system has also purchased eight locomotives, designed for fast running with heavy trains. It has laid additional tracks, until it now has 24 miles of double track between Chicago and Thornton. From Thornton to Port Huron the line is single track. Mr. Geo. B. Reeves, Traffic Manager, estimates that the regular trains can carry 500 more passengers daily westbound than they do now. The Pullman and the Wagner car companies, both of which run their cars over the Grand Trunk system, have promised to furnish all the cars that may be asked for. Trains will be run into the Exposition grounds. The company uses the terminal of the Chicago & Western Indiana R. R., in Chicago, as noted in our issue of May 4. It has no exhibit at the Exposition.

New York, Ontario & Western Ry.—On May 28, this road began running through sleeping cars on its morning and night trains between New York and Chicago. For the morning train they have elegant new Pullman cars recently constructed. These trains make 35½ hours to Chicago, and as this is a differential route, the passengers can avail themselves of the through cars at the low rate of $28 per round trip. Dining cars are run on these trains. Each train has cars running over the Grand Trunk and Chicago & Grand Trunk roads, and over the Grand Trunk and Wabash roads, so that passengers can select either route. Already the business promises to be very fair. Mr. J. E. Childs, General Manager, informs us that the company purchased last year from the Dickson Mfg. Co., of Scranton, Pa., 17 locomotives; 15 of these were consolidation freight engines and two were mogul engines. It has since purchased six more consolidation and four heavy passenger engines. "The mogul engines we propose to use on our heavy passenger trains which are run during the summer months, and during other periods of the year they will be used in freight service. We have now bought 53 of these consolidation and mogul locomotives from the Dickson Mfg. Co. since the opening of the Scranton division, in June, 1890. The fuel used on these engines is buckwheat coal, and is cheap, costing only 50 to 60 cts. per gross ton, and we find them very economical, and they have given excellent service. We also purchased 500 new gondola coal cars last year and 500 this year, which have just been delivered. These have all been built by the Michigan-Peninsular Car Co., of Detroit, Mich. They are hopper bottom cars and have a capacity of 60,000 lbs. each. We have also just received from the Ohio Falls Car Mfg. Co., of Jeffersonville, Ind., six new vestibuled coaches, which are very fine. They are equipped with all modern improvements, including Frost carbureters. These cars are designed for our vestibuled train to run between New York and Livingston Manor during the summer months for the accommodation of our summer business. The train will consist of one of our new mogul passenger engines, baggage car, vestibuled smoker, five vestibuled coaches and two vestibuled drawing-room cars, making a nine-car train. The windows of all these coaches will be equipped with dust guards and screens, and a new form of roller shade, which is quite an improvement on anything we have used in the past. In addition to the ordinary train service a porter will be employed on this train to look after the comfort of passengers and make himself generally useful. This train will be put on about June 24, leaving New York at 3:00 p. m. and making no stops south of Summitville, except such as may be necessary for grade crossings, fuel and water, and at Middletown station. At Middletown, Wickham Ave., we are just completing a new station at a cost of $40,000, and have there an excellent restaurant in connection with it, which will accommodate several hundred people. We have also just completed a new station at Liberty at a cost of $10,000." Mr. Bradford L. Gilbert was the architect of the Liberty station.

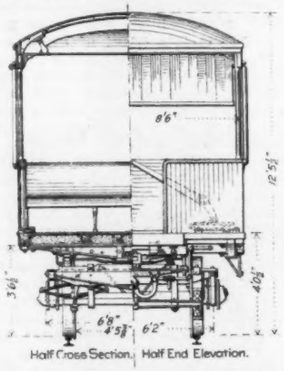
WORLD'S COLUMBIAN EXPOSITION.—XIII.

Fire Protection and Insurance.

A very important feature at an exposition with such immense buildings constructed largely of timber is that of fire protection. The following particulars of the provision made for such protection are abstracted from reports made to the Insurance Auxiliary Committee of the Exposition, by Mr. David S. Beveridge, Assistant Secretary and Inspector, to whom we are indebted for copies of the reports. The roofs of the buildings are fitted with ladders, scuttles, runways and cleated walks, so as to permit a complete fire patrol of the entire roof system. The basement area of the eight main buildings is divided into compartments 150 × 250 ft., by 2-in. plank fitted up tight, having connecting doors from aisles to each compartment. In the construction of walls and columns fire stops were inserted, consisting of plank covered with cement, and in some cases of cement mortar on expanded metal or wire lath; a few large spaces have been treated with tin and iron, as in the construction of fire shutters. This work involved a large additional expense over the contract prices. The general water supply for the grounds and buildings is furnished by the city, from Hyde Park pumping station, where two Gaskill pumping engines of 24,000,000 gallons daily combined capacity have been put in for this special service. In addition there is a plant of four Worthington pumping engines on the grounds, having a combined daily capacity of 40,000,000 gallons. These will take water from the lagoons to supply the boilers and the fountains, and can be thrown on the general system without cutting off the Hyde Park supply entirely. They are expected to meet all requirements in case of fire or of disabilty of the city pumping plant. The average pressure at the pumps is 86 lbs. per sq. in., which can be raised to 100 lbs.; while the two high-pressure fire pumps have 200 lbs. pressure. From the Hyde Park pumping station a 36-in. main is led to the Machinery Building, where it divides, and two 30-in. mains conduct the water throughout the grounds. Each exposition building is surrounded by water mains, 8 ins. to 30 ins. diameter, none less than 8 ins. By May 1, 1893, there were 38 miles of water mains, with a total of 455 hydrants; 255 in the main grounds, 110 in the buildings, 70 on the Midway Plaisance and 20 in the southwest portion called the Willoughby tract; 40 hydrants remained to be placed, making a total of 495.

Each building, except the Fine Art Building (which being of fireproof construction, was specially exempted by the Fire Department), has stand-pipes at intervals of 150 ft., rising to the roof and having hose connections on each floor, gallery and roof. The twelve main buildings have in all 787 hose reels, with 50 to 250 ft. of 2½-in. hose each, and the Manufactures Building has also four hose carts with 600 ft. of hose. The domes of the Administration, Agriculture, Manufactures and Machinery buildings have high pressure standpipes. The 14th battalion of the Chicago Fire Department is located inside the grounds, and consists of 112 men, including officers; it has 8 engines, 2 aerial hook and ladder trucks, 1 Hale water tower, 4 chemical engines, 45 hand hose carts with 27,750 ft. of 2½-in. hose at stated points on the grounds, and 1,500 hand extinguishers and 3,000 brine pails distributed throughout the building. In addition, the fireboat "Fire Queen," built at the request of the Insurance Committee expressly for work in the shallow waters of the canals and lagoons within the grounds, carries 3,000 ft. of 3½-in. and 1,000 ft. of 2½-in. hose; its capacity is equal to three first-class engines. There are 150 fire-alarm boxes and 150 police telephone boxes, 13 of each being in the Midway Plaisance. There will be nine fire engine stations, including the fireboat. The Columbian guard, for police and patrol service, numbers about 2,000 men, under the command of army officers, and they are required to be well posted as to the location of hydrants, fire-alarm boxes, etc. There will also be 2,000 janitors and 500 guides, all similarly posted, and a select force of 500 detectives to look after the criminal class.

Special arrangements have also been made in regard to the oil fuel supply for the main boiler plant, and any one of the 26 firemen and water tenders can, by pressing his push-button, stop the feeding of oil from the pumping station and cause its removal from the whole system in about five minutes. The fuel oil supply plant has already been described in our columns.

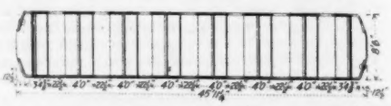


Car of Intramural Railway; World's Columbian Exposition.

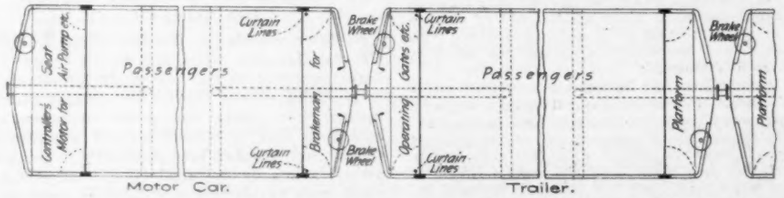
The amount of insurance aimed to be carried by the Exposition management on its own buildings is $5,000,000. Insurance on state and foreign buildings, exhibits and the various concessions for pleasure and profit is attended to by their owners.

Cars of the Intramural Railway.

The elevated electric railway through the Exposition grounds, and the power station for the road, have been illustrated and described in our issues of Oct. 20, 1892, and April 6, 1893. This week we present drawings of the cars used on this railway. The cars are open, and have cross seats and side doors like the cars run by Illinois Central R. R.



Plan of Car of Intramural Railway.



PART PLAN OF TRAIN OF INTRAMURAL RAILWAY, SHOWING ARRANGEMENT OF COUPLINGS, ETC.

between the city and the Exposition grounds (Eng. News, Nov. 17, 1892, and May 11, 1893)), the purpose of this arrangement being to facilitate prompt entrance and exit of passengers. On the intramural railway there are numerous stops. The trains consist of a motor car (with from 50 HP. single-reduction motors) and two to four trail cars. The cars were built by the Jackson & Sharp Co., of Wilmington, Del.

The cars have seven compartments, accommodating twelve passengers each, and have low sliding doors. The exterior is painted brown ochre. The interior finish is of ash, with oak veneer ceiling, and the seats are of alternate slats of ash and cherry. The floor is of Georgia pine planks $\frac{7}{8} \times 3\frac{1}{2}$ ins. The trucks have 36-in. cast iron wheels, and the cars are fitted with the New York air brake. The drawbars are pivoted on the truck centers, and the coupling arrangement is similar to that used on the Chicago elevated railways. The general dimensions of the cars are as follows:

Length over platforms	45 ft.	11¼ ins.
Width over frames	8 "	6 "
Height, rail to top of roof	12 "	5½ "
" rail to floor	4 "	0½ "
Wheel base, truck	5 "	0 "
" total	32 "	3½ "
Dist., c. to c. of trucks	27 "	3½ "
Wheels, diameter	3 "	0 "
Weight of car body, about	16,600 lbs.	
" of two trucks, "	11,000 "	
" of car, total	27,600 "	
" of four motors	13,880 "	
" of resistance boxes	1,000 "	
" of controller	1,000 "	
" of air pumps	1,200 "	
" of motor car, total	44,680 "	
Capacity	84 passengers.	
Cost, approximate	$2,500	
Brake	New York Air Brake Co.	

the way of a six-wheel passenger truck which is used in connection with the New York Airbrake Co.'s exhibit, and also electric car trucks in the Electrical Building, used in connection with the General Electric Co.'s exhibit. The Harvey Steel Car & Repair Works, of Harvey, Ill., whose cars are referred to elsewhere, exhibits three of its steel cars: a tank car (without tank), a gondola coal car and a box freight car. The frames of these cars are entirely of steel, composed principally of standard sections and shapes manufactured by most steel works.

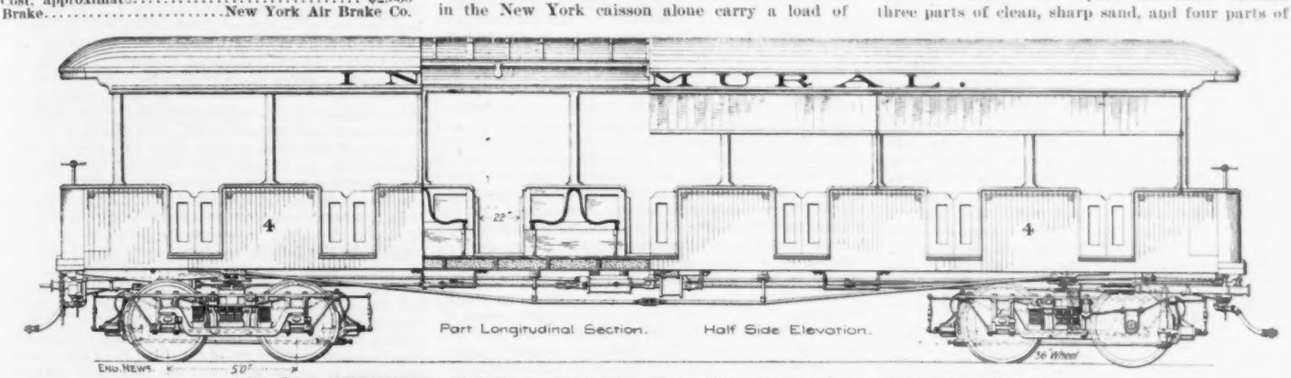
SILICA GRAVEL CONCRETE.

In a pamphlet lately published by Mr. A. G. de Smedt, upon the use of silica gravel in concrete, he quotes as a well known fact the greater adhesion of hydraulic cement to clean silica gravel than to broken limestone, and consequently giving better results in concrete. In proof of this statement he gives several illustrations of this use of gravel in large public works. Gravel concrete was used exclusively in the foundations of both towers of the Brooklyn bridge, and the 8,000 tons of concrete in the New York caisson alone carry a load of

cent examination shows that the concrete is absolutely intact, with not the slightest abrasion around the outside edge, says Mr. Smith.

Maj. D. P. Heap, U. S. Engineers, in his specifications for a sea-wall at Staten Island, calls for a concrete deposited in bags and made as follows: One part Portland cement, two parts clean, sharp sand, three parts pebbles and four parts of stone broken to pass through a 2-in. ring.

In the construction of the old Croton Aqueduct, commenced in 1838, concrete was made largely of gravel or pebbles, and it has proved solid and water-tight. Chief Engineer Birdsall says that the present practice of his engineers in making concrete is to use one part cement, two parts sand and three parts of stone or gravel; this makes a concrete practically water-tight. The specifications for the new Croton dam call for a concrete made of "sound broken stone or gravel, not exceeding 2 ins. in their greatest diameter." Mr. James Renwick, the last survivor of the engineering staff of the old Croton Aqueduct, says that in building the 42d St. distributing reservoir, he used a concrete made as follows: One part Rosendale cement, three parts of clean, sharp sand, and four parts of



CAR FOR INTRAMURAL ELECTRIC ELEVATED RAILWAY, WORLD'S COLUMBIAN EXPOSITION.

The number of cars is 65, of which 18 are equipped with motors. The motor cars are similar to the others, with the exception that one seat has been taken out for additional room at the trailer end. The doors are operated by the brakeman by means of levers on the platforms, and one brakeman can operate the doors of two cars. The curtains are also operated by the brakeman. The conductor rides between the first and second cars, and the brakeman between the third and fourth; and the cars are so arranged that the levers pulling side doors come at those places. The bell rope runs from the last car in the train to front of the second car, and another from the front of the second car to the motorman. The brakeman gives electric bell signals to the conductor and the conductor to the motorman. The motors were made by the General Electric Co.

The trains are made up of four cars, including the motor car, and each car will comfortably seat 84 passengers. The average speed is 12 miles per hour, and there are 18 stops in the round trip of 6½ miles, averaging 15 seconds to each stop. The time of trip from one end of the line to the other is 19 minutes. The fare is 10 cts. between terminals or intermediate stations. Travel has not been very heavy as yet, averaging about 10,000 passengers per day. We are indebted to the Jackson & Sharp Co. and to Mr. C. P. Matlack, Chief Engineer and Superintendent of the railway, for the detailed information given above.

Notes on Car Exhibits.

The Jackson & Sharp Co., of Wilmington, Del., has entered as exhibits the cars of the intramural railway, which we describe above. It also has on exhibition one first-class standard passenger car of the Chicago, Burlington & Quincy R. R.; and for the government the company has furnished at its own expense, and loaned to them for their service, a first-class standard postal car in which they are distributing the mail just as it is done upon the road. A portion of the side of the car has been removed so that visitors can witness the handling of the mail. At the close of the Exposition, this car will be placed upon the Chicago, Milwaukee & St. Paul R. R., which has agreed to purchase it. The company has other exhibits in

7 tons per sq. ft. This concrete was made of one part Rosendale cement, two parts sand and four of clean gravel, by measurement, and it has carried its load without any appreciable settlement since 1872. Gravel concrete was also used 20 years ago by the same engineer, Mr. C. C. Martin, in building the Prospect Park reservoir, in Brooklyn, and it is in perfect condition to-day.

In 1871 Mr. F. Hopkinson Smith used gravel mixed with equal parts of broken stone in building the foundation for the Race Rock lighthouse, in Long Island Sound. Mr. Smith said he used gravel in mixing large masses of concrete because its rounded surfaces pack more closely in the interstices of the broken stone, and because there is no possibility of "arching," as sometimes occurs where broken stone is used alone, even when the presumption is that the concrete has been thoroughly rammed.

The founding of this Race Rock light was a difficult piece of work, as it lay opposite the mouth of the Connecticut River and had to withstand the thrust of immense fields of floating ice, which sometimes piled on the base of the structure to a height of 30 ft. To meet these conditions an ellipitical, artificial island was first formed, 175 ft. long by 125 wide. The interior of this island was then excavated in a circle of 100 ft. in diameter. An iron caisson, 12 ft. high, was then sunk, and this was filled with concrete mixed as follows: One part English Portland cement, two parts sand, three parts screened gravel and three parts of broken trap rock. When mixed this made by measure 1 cu. yd. of concrete to the barrel of cement of 400 lbs. The mass when placed was 12 ft. thick, 69 ft. in diameter at the base, and 57 ft. at the top, and contained 29,000 cu. ft. of concrete. Upon this was built a masonry pier, 54 ft. in diameter and 28 ft. high, in the form of a frustrum of a cone, faced and backed solid with Cape Ann granite. Including the granite house of the keeper, the whole superstructure weighed about 5,000 tons. All of the concrete was mixed on the site, in a horizontal mixer, and then run into 1 yd. iron valve buckets, which were lowered through the water and dumped so as to form a continuous mass. Only salt water was used in mixing. Regravel from the north shore of Long Island. This gravel was nearly pure white quartz in masses not exceeding 1 in. in diameter. This reservoir has 12 ins. of concrete over the bottom puddle and holds 20,000,000 gallons of water at a depth of 36 ft.

PERSONALS.

Mr. Arthur Thorpe has been elected City Engineer of Greencastle, Ind.

Mr. P. F. Hodgson has been appointed Engineer of Signals on the Grand Trunk Ry., with office at Montreal.

Mr. W. T. Griffith has opened an office in the Mallery Building, Chicago, for carrying on a general practice in hydraulic and railway engineering.

Mr. A. A. Robinson has been elected President of the Mexican Central R. R., and Mr. R. H. Symon, of London, has been elected Vice-President.

Mr. Wm. L. Saunders, Engineer of the Ingersoll-Sergeant Drill Co., and an expert on compressed-air, has gone to Europe to investigate some compressed-air systems of power distribution.

Mr. A. M. Ryon, Professor of Engineering and Mining at the School of Mines, College of Montana, has been appointed President of the Montana College of Agriculture and Mechanic Arts.

Prof. Wm. P. Mason, of the Rensselaer Polytechnic Institute, expects to sail for Europe on June 17, where he will remain for some eight months and make a study of European water supplies from a sanitary standpoint.

Charles H. Haswell, author of a well known engineer's pocket-book, is in the 84th year of his age, and is still in active practice as a civil and mechanical consulting engineer, and is also a City Surveyor of New York.

Mr. J. S. Jeans, who recently resigned the position of Secretary of the Iron and Steel Institute, which he had held for 16 years, has accepted the position of editor of the "Engineering Review," a London monthly paper.

Mr. F. W. Fratt, formerly Chief Engineer of the Wisconsin Central Ry., and later Chief Engineer of the Houston extension of the Missouri, Kansas & Texas Ry., has been appointed General Manager of the Sherman, Shreveport & Southern R. R. His office will be at Shreveport, Tex.

Mr. W. S. Jones has resigned his position as Chief Engineer of the Chicago Union Transfer Co., and

opened an office in the Mallery Building, Chicago, for carrying on a general practice in engineering. He is at present consulting engineer for the water-works, sewers, etc., at Cicero and Austin, Ill.

Mr. I. A. Sweigard, General Manager of the Philadelphia & Reading R. R., has been appointed General Superintendent of the Main Line Division, vice Mr. M. Lawler, appointed Manager of the Atlantic City Division. Mr. Theodore Voorhees, First Vice President, will also assume the duties of General Manager.

Mr. George Cadogan Morgan, Chicago, has been engaged to prepare plans for the distribution system of water-works at Harlem, Ill. Mr. Morgan has designed about 60 different systems of water-works, and among plants recently completed are those at River Forest, Monticello and Metropolis, Ill., and Delphi, Ind.

Mr. Theodore West, Chief Draftsman of the Darlington locomotive shops of the Northeastern Ry., England, has resigned, after 20 years of service with that company, and has retired from business. He has had experience on the Australian railways, and has made a special study of locomotive history and development, upon which subject he has written and lectured considerably.

Mr. Adolphus Bonzano, Vice-President and Chief Engineer of the Phoenix Bridge Co., has tendered his resignation, and severed his connection with the company on June 1, after having been its virtual head for more than 25 years. We understand that he expects in a short time to resume active business with other parties. Mr. John Sterling Deans, heretofore Principal Assistant Engineer, has been appointed Chief Engineer of the Phoenix Bridge Co.

Mr. F. M. Roberts, of Toronto, Ont., is to take charge of sewerage work at Orrville, O.; Mr. John Pownall, of Wilmington, Del., has a similar position at Martin's Ferry, O., and Mr. William H. Cushman, of Boston, Mass., is engaged at Sistersville, W. Va., on a sewerage system. All of these named obtained their positions through the "want columns" of Engineering News, in answer to the advertisement of Mr. Alexander Potter, of New York, who is extensively engaged in the construction of sewerage systems in the towns named, and in other places.

Prof. E. A. Fuertes, M. Am. Soc. C. E., of Cornell University, and Mr. Rudolph Hering, M. Am. Soc. C. E., of New York, the well known expert on sewerage matters, have been retained by the government authorities of the Province of San Paulo, Brazil, to prepare plans for improving the sanitary condition of the city of Santos. Mr. J. H. Fuertes has assisted in the preparation of the designs for the work. The city has an extremely bad sanitary reputation, so bad that the recommendation was once made to abandon it and burn it, but, as it is situated on one of the few good harbors of Brazil, this remedy was considered too heroic. The population is about 25,000, and in one year as many as 2,500 persons died of typhoid fever. Santos is the coast terminus of the San Paulo Railway.

Prof. Moses G. Farmer, the electrician, died at Chicago, May 25. He was born at Boscawen, N. H., in 1820, and graduated from Dartmouth College in 1844. He devoted himself to the study of electricity, and in 1846 invented an electro-magnetic machine, which he used to drive a lathe in his workshop. He also invented and constructed an electric clock. An appointment to open a telegraph office for the New York & Boston Magnetic Telegraph Association, at South Framingham, Mass., and to superintend repairs between Boston, Worcester and Springfield, gave him an opportunity to experiment on telegraphing by means of outside currents, and he contrived and constructed models of apparatus for fire alarms, bells, etc. In 1851 he became connected with Dr. W. F. Channing, of Boston, and they perfected a system of fire alarms under an appropriation of $10,000 by the Boston city government for this purpose. This resulted in Mr. Farmer's appointment as superintendent of construction of the Boston fire alarm telegraph, which was the first of the systems now in such general use throughout the country. In 1872 he accepted the position of electrician at the U. S. Naval Station, at Newport, R. I., which he resigned in 1881 on account of ill-health. He was the inventor of a large number of electrical appliances, and in 1839 lighted his house at Salem, Mass., by electricity, which is said to have been the first application of the electric light to domestic use.

NEW PUBLICATIONS.

JUNE MAGAZINES.—The "Popular Science Monthly" has for its leading article a paper on "Irrigation in the Arid States," accompanied by fine half-tone engravings illustrating irrigating scenes in various parts of the far West. It is an excellent account of the irrigation movement, although of necessity brief. The statistics given show that in 1891 17,177,843 acres in the United States were "under ditch," of which not quite one-half was under cultivation. This means that capital has taken hold of irrigation enterprises faster than settlers and cultivators have come forward to till the land thus made productive. The average first cost of irrigation in California is $8 per acre. The extremes are $2.56 and $83 per acre, the latter being the cost in the orange groves of Riverside, where a pipe system is in use. The tides in the Bay of Fundy and the physical geography of that very interesting region are described in an excellent paper by Frank H. Eaton. In the "Californian" are two papers on the Grand Canyon of the Colorado, which can be reached now by an easy stage ride from Flagstaff, Ariz. One of the papers is finely illustrated, and describes a tour to the canyon. The other, by Mr. R. H. Drayton, describes the dynamic geology of the Grand Canyon region. The number contains also a description of the Lick Observatory on Mt Hamilton, with its famous 36-in. telescope, and an excellent summary of the explorations which have been made in South Polar seas. In the "Century" is a paper describing the experience of a Swedish gentleman who spent a portion of the winter of 1891-2 in the Russian famine districts assisting Count Tolstoi in his relief work. The paper is illustrated from photographs taken by the author. In "Harper's" Julian Ralph writes of Wyoming, which he calls "another Pennsylvania." He considers, however, that the state's agricultural resources are of greater importance than even its mineral wealth. His discussion of the irrigation question in the state and of the manner in which the rivalries between different claimants of water rights are being solved is of great interest and value. The number also contains a valuable paper on brain surgery by Dr. W. W. Keen. "Scribner's" has for its second paper in the series on "Men's Occupations" a finely illustrated description of life in a logging camp in the Northwest.

The "North American Review" reprints the last chapter of the new edition of Andrew Carnegie's "Triumphant Democracy." The writer entitles it "A Look Ahead," and prophesies a union of all English-speaking nations under one government—a "greater United States" he calls it. He paints a glowing picture of the benefits which would flow from such a union, and is very sanguine that it would be welcomed by everyone. Mr. J. H. Biles, Professor of Naval Architecture in Glasgow University, writes on "Thirty Knots an Hour to Europe." He holds that such speeds are by no means impossible, considered purely as a matter of engineering. The question is whether passengers enough can be secured to pay for the enormous expense of running such vessels with their great cost and limited cargo capacity. Nickel-steel boilers of new and lighter design, oil fuel, higher pressure of forced draft, and increased depth of vessels are among the changes he proposes to obtain increased speed. In the "Review of Reviews," Mr. H. H. Windsor has a brief paper on transit facilities in Chicago and at the World's Fair.

A PRACTICAL TREATISE ON FOUNDATIONS, explaining fully the Principles Involved, with Descriptions of all the Most Recent Structures, accompanied by Numerous Drawings; also an Accurate Record of the Bearing Resistances of Materials as Determined from the Loads on Actual Structures. By W. M. Patton, C. E., formerly Professor of Civil Engineering at the Virginia Military Institute; engineer in charge of the Mobile River, Ohio River, Susquehanna River and Schuylkill River bridges; late Chief Engineer of the Mobile & Birmingham and of the Louisville, St. Louis & Texas railways. New York: John Wiley & Sons. 8vo. Cloth. Pp. 402. Many folding plates. $5.

The author of this work has not only taught engineering, but is himself an engineer of wide experience, and has had in his charge the building of some very important bridges in the United States. His treatment of his subject is thus from the standpoint of the practical man of experience. While many of his recommendations are necessarily based upon the experiments and experiences of others, his authorities are quoted and he has usually added remarks deduced from his own practice. The chief value of this work lies in the detailed descriptions of work upon which he has been personally engaged, which he illustrates by dimensioned drawings, and for which he gives much very useful detail relating to the methods of work and especially as to the cost. His chapter on pneumatic caissons is very full and abounds in bits of advice and general cautions that can only come from one thoroughly familiar with the practice of this process for securing foundations. In his chapter on foundations for high structures Mr. Patton has collected, and here gives with his comments, the latest statistics of loads imposed per unit of area as deduced from the prominent bridges of the world and the later high buildings. In this chapter are also included some very interesting experiments upon the skin friction of caissons as made by the author in sinking the foundations of the new Susquehanna River bridge, at Havre de Grace, Md. Every known type of foundation is described and illustrated, and these descriptions are usually accompanied by detail of cost under the conditions assumed. As would be expected from an engineer who has had to deal with the swamps of the South the portion of the work relating to pile trestles, pile dikes and jetties and pile foundations of all kinds is especially detailed and valuable. One whole chapter is devoted to the cost of timber trestles and the discussion of dimensions and arrangement under differing conditions, and embankments of earth on swamps naturally follow this chapter. The author's work will be appreciated by many readers, especially among the younger engineers, for his treatment is plain and mathematics as little used. We regret, however, that the publishers did not insert the illustrations in the text where they are referred to, instead of putting them as folded plates at the end of the volume. This latter is a practice especially to be condemned in books of this character, and the fact that the cuts in this case are mounted on guards so that they can be turned out opposite to the text, practically adds little to their convenience.

THE PERMANENT WAY POCKET-BOOK. By T. W. Jones, Vice.-Pres. Inst. Permanent Way Inspectors. Calcutta: Thacker, Spink & Co. Oblong; 12mo; pp. 128.

Considering that this work is chiefly intended for East Indian use it is certainly a most creditable publication. If it correctly represents Indian practice, many American methods are making their way there, as, for instance, the designation of curves by their degree instead of radius. The work has a good many strong points, and but few weak ones which demand correction. We note a number of points on which we should be disposed to differ somewhat, but they are all such as give legitimate ground for difference. As the work is not designed for general use out of India, it would be of little use for us to discuss these issues, and, moreover, they are for the most part those where the author has preferred to follow some local or English practice in preference to American—a natural preference which it is idle to dispute over. In the note on pile-driving on p. 99, N is misprinted for H, and the formula itself is dubious, giving too great loads for small penetrations; 6 (D + 1) in place of 8D, gives a much safer and more correct denominator, the formula then becoming what has become known as the "Engineering News Formula." The standard dimensions "sanctioned by the government of India" present some curious anomalies in American eyes. For instance, embankments must be at least 20 ft. wide (for 5 ft. 6 ins. gage), and cuttings only 18 ft. wide, "excluding side drains." The clearance for curve guard rails is fixed at 2 ins., which is extremely bad practice on all ordinary curves, since it relieves the flange wholly from action, and throws all normal guiding upon the guard rail. This is right and proper with frog and crossing guard rails, but the curve guard rail should be so spaced as to come into action only as the flange begins to mount the outer rail, requiring a spacing of some 3½ to 4 ins. Only on extremely sharp curves like the 90-ft. radii of the elevated lines, where the guard rail is kept constantly lubricated, is it good practice thus to throw a curve guard rail into constant action. The maximum load per driving axle "under any circumstances" is fixed at 15 tons, which is much within American limits.

TRADE PUBLICATIONS.

RAILWAY GUIDE.—New York, Ontario & Western Ry. Co. New York: J. E. Childs, Gen. Man.; J. C. Anderson, Gen. Pass. Agent. 8vo; pp. 176; illustrated.

This is the 1893 edition of "Summer Homes," giving descriptions of the resorts along the line, with details of hotels and boarding houses, and numerous photographic illustrations. Some particulars of the road's equipment and train service are given in another column.

THE EVOLUTION OF ARTIFICIAL LIGHT. Omaha: Pass. Dept. Union Pacific Ry. 12mo; paper; pp. 107; illustrated.

We have not seen anywhere a more novel and interesting method of advertising a railway's passenger service than this little book. It is really what its title purports—an outline of the evolution of artificial light, and especially the application of artificial light to car-lighting, from the pine knot to the Pintsch gas lamp of the present day. The last few pages of the book only are devoted to a description of the Union Pacific passenger lines; and these are so finely illustrated by half-tone engravings from photographs of scenery in the Far West that it is by no means the least interesting portion of the book. The two inventions of the photographic dry plate and the half-tone process of engraving have transformed such books as this; and, in place of the caricatures of a few years ago, we now have in many of the illustrations real works of art.

THE COMPTOMETER.—Felt & Tarrant Mfg. Co., Chicago, Ill. 12mo.; pp. 27; illustrated.

This pamphlet describes the comptometer machine for performing addition, multiplication, square root and other mathematical calculations, which was illustrated and described in our issue of Dec. 15, 1892.

ELECTRICITY.—General Electric Co., New York; 8vo.; pp. 16; illustrated.

This is a popular account of the growth of electrical industries, with illustrations representing its numerous applications.

TRACK TOOLS.—The Verona Tool Works, Pittsburg, Pa. 29 blue prints of track tools; 9 × 12 ins.

An exceedingly novel and useful catalogue has just been issued by the Verona Tool Works, consisting of

blue prints made to scale, and with complete dimensions of various patterns of track tools made by the works. The list includes claw bars, tamping picks, spike mauls, pinch bars, lining bars, rail tongs, spike pullers, rail benders, etc., including, in some cases, standards of several different roads. We note that sales of the Verona nutlock reached the total of 201,015,199 on Feb. 25, 1893. Counting 4 bolts to a joint and 30 ft. rails, this number of nutlocks would equip over 142,000 miles of track.

SOCIETY PROCEEDINGS.

NEW YORK RAILROAD CLUB.—At the meeting on May 18 technical subjects were discussed as follows:

Proper Sizes for Arch-Bars.—A letter was read from Pulaski Leeds, Supt. of Motive Power of the Louisville & Nashville, stating that that road had more wrecks and detentions of cars from broken arch bars and column bolts than from any other cause. He thought too many cars in the country had had their capacity raised by the use of the paint brush only.

M. Mitchell said the Erie had increased the dimensions of arch bars on 60,000-lb. cars as the result of breakages, and the present dimensions are: Top bar, 1⅝ × 4 ins..; inverted bar, 1¼ × 4 ins.; tie bar, ¾ × 4 ins.. The bars are bent with easy curves, and 1¼ in. box bolts and frame bolts are used. Truck frames with these dimensions give no trouble.

Mr. Mendenhall, of the Pennsylvania, said the failures in arch bars which had come under his notice had been through the column bolt holes, but the breakages had not been numerous.

President Blackall said the Delaware & Hudson used Glen Iron steel for arch bars and bolts. The bolts have double nuts and a cotter underneath. The arch bars are 4½ × 1 in.

Mr. Baker said the Pennsylvania used on 50,000-lb. cars 1 × 3½-in. arch bars at both top and bottom, with 1-in. column bolts. On 60,000-lb. cars both bars are 1⅛ × 4 ins., with 1⅛ column bolts double nutted.

Messrs. Pomeroy, Mitchell and Montgomery discussed the practice of the New York Central in applying a column yoke as well as the column bolts. Opinions differed as to whether the yoke was a wise safeguard, or whether it were better practice to so design the truck frame and bolts that breakages would not occur. Messrs. Baker, Mitchell and Montgomery were appointed a committee to formulate resolutions on the subject.

Using Water on Locomotive Axle Bearings.—Mr. Mitchell said the Erie had several locomotives with water pipes running to the driving axles and truck boxes. They were not so equipped for lubrication, but to keep the boxes cool and allow the train to make the end of a division without stopping, when, without the water, a stop would have to be made to cool off the box. In the engines thus equipped, one pair of drivers is under the firebox, very close to the grates, and with the engine standing still on a summer day the axle will be too hot to bear the hand on. Even these boxes, however, on a straight line, give little trouble by heating if kept well lubricated; but on the Delaware division, with its numerous curves, the heating is very apt to occur. The water washes off the oil, it is true; but the journals do not cut with the water, whereas they might cut if allowed to get hot. He did not believe in the practice, except as an expedient for an emergency to enable engines with too heavy pressure on the bearings to do their work. With other engines having a less pressure per square inch of journal, oil lubrication gives perfect results, and no water is needed.

Mr. Rogers stated that the Baltimore & Ohio had at one time lubrication pipes on its passenger engines running to the driving boxes and the front truck, and a connection was made to the pump so that if a box began to heat a stream of water could be turned into the pipes. It worked very well.

Mr. Snow said that a stationary engine which furnished power to drive the Ramapo works had its pillow block located not far from the drop used for breaking up old wheels. The jar caused the pillow block foundation to settle, and it was necessary to keep a stream of water running on the bearing to keep it cool until the location of the drop could be changed. The water was used nearly a month, and the journal wore ⅛ in. in that time.

Mr. Lewis said that he had practiced cooling bearings by playing a jet of water on the side of the flange of the box, which did not interfere with the lubrication. Mr. Montgomery said that he followed a similar practice.

Treatment of Steel.—A long discussion took place on this subject, in which it appeared that many roads were punching steel without reaming, and were not even annealing their boiler plate. Mr. Sampson Fox, of Leeds, England, said that he would strongly advise drilling instead of punching for all plates which were to be exposed to the fire. Drilling holes with good machinery is actually cheaper than punching. He also urged annealing after drilling. After handling many thousand tons of flanged work he had found that success came by the most careful and thorough annealing.

In the further discussion it appears that in the Lackawanna shops, plates are punched and reamed but are not annealed. Mr. Blackall, on the Delaware & Hudson, anneals after reaming. Messrs. Colvin and Montgomery thought that the failures of side sheets could not be traced to punching. The quality of the steel was the matter of chief importance.

It was voted that the Club adjourn during the summer months, and that the next meeting be held on the evening of Sept. 21.

CONNECTICUT ASSOCIATION OF CIVIL ENGINEERS AND SURVEYORS.—The spring meeting was held at New Britain, Conn., May 31, and was a notable event in the history of the Association on account of the special invitation which had brought the meeting to that city, the large number of members and visitors in attendance, and for the excellent program which had been arranged, and which was well carried out. The meeting was held at New Britain in response to the invitation of the Board of Water Commissioners of that city, Mr. Percy M. Blake, Chief Engineer of the improvements which have been made at the Shuttle Meadow Reservoir, and Mr. R. W. Sherman, President of the Troy Public Works Co., the contractors by whom the work has been done.

The Board of Water Commissioners hospitably provided a hall for the meeting; and a fine dinner (served a la Russe, and consuming much more time than the matter-of-fact, hard-working engineers and surveyors considered strictly necessary or profitable), carriages to the reservoir works, and refreshments ad libitum, were provided by the hosts of the occasion, who individually and collectively were on hand to welcome the guests and make them mutually acquainted, and personally see that each person present was given every attention. The following program was carried out in its entirety. The "remarks" by Mr. Stearns and Dr. Drown were very interesting and very practical, and should be read by every engineer who has to do with the construction of sewers or water-works; they were reported in full by the official stenographer, together with the discussions on them and on other papers, and will be published in the official proceedings of the meeting, which will be issued in a short time. The important paper of the meeting was the one read by Percy M. Blake, engineer of the reservoir works, and which we shall publish later on, with illustrations. The reservoir dam and appurtenances were inspected with much interest, and the engineer and the commissioners may well feel proud of the work, while the citizens of New Britain may congratulate themselves on the ample supply of excellent water. The Board of Water Commissioners consists of Messrs. Philip Corbin, Chas. H. Beaton, and Jas. W. Ringrose.

The program commenced by brief addresses of welcome by the Mayor and Chairman of the Board of Water Commissioners, and a response by the President of the Association. Business was then transacted, after which a paper was read on "Some Practical Suggestions as to Processes and Methods for Duplicating Drawings," Edgar Clark, Putnam, Conn. An improved pantograph, recently invented by one of the members of the Association, was exhibited, and a brief address on "Sanitary Progress in Massachusetts, in Water Supply and Sewerage," was made by Mr. F. P. Stearns, Engineer of the Massachusetts State Board of Health, Boston, Mass.; followed by an address on "Water for Domestic Uses," by Dr. T. M. Drown, of the Chemical Department, Massachusetts Institute of Technology, and Analyst of the State Board of Health, Boston, Mass. A paper on "The New Dam and Other Improvements at the New Britain Water-Works Reservoir," was read by Mr. Percy M. Blake, Chief Engineer, Hyde Park, Mass.; and remarks on the new dam were made by Mr. T. H. McKenzie, Southington, Conn., one of the state engineers for inspecting dams. The meeting then adjourned for dinner, after which there was the excursion to the new reservoir.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.—The next meeting will take place at the Kimball House, Atlanta, Ga., Sept. 21. The subjects for discussion will be as follows: 1, The Best Methods of Securing Cylinders, Smokeboxes and Frames together with Special Regard to Avoiding Trouble with Loose Cylinders; R. P. C. Sanderson, Pulaski Leeds and Thos. W. Gentry. 2, The Best Methods of Cleaning and Banking Fires, and to Recommend the Best Practice to Be Followed with Different Styles of Fireboxes to Avoid Troubles from Leaky Flues, and Strains in Firebox Sheets; C. B. Gifford, Geo. D. Harris and J. J. Anderson. W. J. Hartman, J. M. Holt and R. E. Libby are expected to report on "Air Brake Practice, Piston Travel in Inches and Determination of the Actual and Available Brake Power." Philip Wallis, T. W. Gentry, W. Hassman and A. T. Hooker are xpected to report on "Soft Plugs for Crown Sheets of Fireboxes, Best Form and How to Keep Them Effective."

Macon, Ga. S. A. Charpiot, Secy.

BOSTON SOCIETY OF CIVIL ENGINEERS.—The regular monthly meeting was held May 17, Mr. John R. Freeman, President, in the chair and about 75 members and visitors present. Mr. Dexter Brackett gave a short account of the freezing of the mains supplying water to Long Island, in Boston Harbor. About 1,200 ft. of 6-in. pipe, laid with the Ward flexible joint across a channel between Moon and Long islands, was frozen during the past winter. The pipe, where frozen, was constantly covered with from 15 to 25 ft. of water, and the freezing was due to the fact that the salt water of the harbor, by which the 6-in. pipe was surrounded, was cooled by the severe cold to the temperature of 28° F. Many of the pipes, instead of being burst by the freezing water, were separated at the joints; that is, the spigot ends of the pipes were drawn entirely out of the bells into which they had been leaded.

The discussion, "The Measurement and Value of Water Power," was commenced, and as several members were prepared to take part in the discussion it was voted to continue it at the meeting on June 21.

S. E. Tinkham, Secy.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—At the meeting on June 7, Mr. W. H. Jaques, M. Am. Soc. C. E., Ordnance Engineer at the Bethlehem Iron Works, read a paper, illustrated by a number of stereopticon views, on "The Manufacture of High-Power Ordnance, with Special Reference to the Wire-Wrapped Gun."

A recent letter to the secretary from F. W. Newel, topographer, states as follows: "Should you happen to know of engineers particularly interested in this subject, I would be greatly obliged if you will send their names and addresses, that I might place some of the copies of the 'Report on the Hydrography of the Arid Regions of the United States,' in the hands of persons who may make use of them."

MONTANA SOCIETY OF CIVIL ENGINEERS.—The regular monthly meeting will be held June 10, at the office of Sizer & Keerl, in the Atlas Block, Helena, Mont. The question of "Manufacturing Industries in Montana," will be discussed. G. O. Foss, Secy.

COMING TECHNICAL MEETINGS.

MONTANA SOCIETY OF CIVIL ENGINEERS.
June 10. Secy., G. O. Foss, Helena.
ENGINEERS' CLUB OF KANSAS CITY.
June 12. Secy., Waterman Stone, Baird Building.
WISCONSIN POLYTECHNIC SOCIETY.
June 12. Secy., M. F. Schinke, City Hall.
DENVER SOCIETY OF CIVIL ENGINEERS.
June 13. Secy., F. E. King, Jacobson Block.
ATLANTA SOCIETY OF CIVIL ENGINEERS.
June 13. Secy., Parker N. Black, Capitol Block, Atlanta, Ga.
CIVIL ENGINEERS' CLUB OF CLEVELAND.
June 13. Secy., F. C. Osborn, Case Library Bldg.
NORTHWEST RAILROAD CLUB.
June 13. Ryan Hotel, St. Paul. Secy., W. D. Crosman.
NORTHWESTERN SOCIETY OF ENGINEERS.
June 13. Secy., D. W. McMorris, Burke Block, Seattle, Wash.
MASTER CAR BUILDERS' ASSOCIATION.
June 13. Lakewood, N. Y. Secy., J. W. Cloud, Buffalo, N. Y.
CIVIL ENGINEERS' ASSOCIATION OF KANSAS.
June 14. Wichita, Kan.
NEW ENGLAND WATER-WORKS ASSOCIATION.
June 14, 15, 16. At Worcester, Mass. Secy., R. C. P. Coggeshall, New Bedford, Mass.
NEW YORK RAILROAD CLUB.
June 15. Secy., H. G. Prout, 73 Broadway N. Y.
ENGINEERS' CLUB OF CINCINNATI.
June 15. Secy., J. F. Wilson, 24 W. 4th St.
SCANDINAVIAN ENGINEERING SOCIETY OF CHICAGO.
June 15. Secy., C. F. Franson, Portland Block.
TACOMA SOCIETY OF ENGINEERS AND ARCHITECTS.
June 16. 201 Washington Building.
NORTHWESTERN TRACK AND BRIDGE ASSOCIATION.
June 16. Secy., D. W. Meeker, St. Paul.
ENGINEERS' CLUB OF PHILADELPHIA.
June 17. 1122 Girard St. Secy., L. F. Rondinella.
SWEDISH ENGINEERS' CLUB.
June 17. Secy., P. Valentine. At 281 Union St., Brooklyn, and 646 North 10th St., Philadelphia. At 190 La Salle St., Chicago. Secy., John Ericson.
AMERICAN RAILWAY MASTER MECHANICS ASSOCN.
June 19. Lakewood, N. Y. Secy, Angus Sinclair, New York.
COLUMBIAN ENGINEERING SOCIETY.
June 20. Secy., F. W. Hart, Washington, D. C.
ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.
June 20. Secy., E. H. Clark, Pittsburg.
BOSTON SOCIETY OF CIVIL ENGINEERS.
June 21. Secy., S. E. Tinkham, 36 Broomfield St.
ENGINEERS' CLUB OF ST. LOUIS.
June 21. Secy., Arthur Thacher, Odd Fellows' Building.
AMERICAN SOCIETY OF CIVIL ENGINEERS.
June 21. Secy., F. Collingwood, 127 East 23d St., New York.
CANADIAN SOCIETY OF CIVIL ENGINEERS.
June 23. Secy., C. H. McLeod, Montreal, P. Q.
WESTERN SOCIETY OF ENGINEERS.
July 5. Secy., Jno. W. Weston, 51 Lakeside Bldg., Chicago.
ENGINEERS' CLUB OF MINNEAPOLIS.
July 6. Secy., E. Nexsen, 504 Kasota Block.
ASSOCIATION OF CIVIL ENGINEERS OF DALLAS.
July 7. Secy., E. K. Smoot, 808 Commerce St.
TECHNICAL SOCIETY OF THE PACIFIC COAST.
July 7. Secy., O. Von Geldern, 719 Market St., San Francisco.
ENGINEERS' AND ARCHITECTS' CLUB OF LOUISVILLE.
July 12. Secy., F. W. Mowbray, Norton Building.
ENGINEERING ASSOCIATION OF THE SOUTH.
July 13. Secy., W. G. Kirkpatrick, Nashville, Tenn.
ENGINEERS' SOCIETY OF PHŒNIXVILLE.
Sept. 5. Secy., W. Halliburton.
NEW ENGLAND RAILROAD CLUB.
Sept 13. Secy. F. M. Curtis, O. C. R. R., Boston.
WESTERN RAILWAY CLUB.
Sept 19. Secy., Clement F. Street, Chicago.
ASSOCIATION OF ENGINEERS OF VIRGINIA.
Sept 20. Secy., L. V. Carmalt, Roanoke, Va.
SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.
Sept 21. Secy., S. A. Charpiot, Macon, Ga.
CENTRAL RAILWAY CLUB.
Sept. 27. Secy., S. W. Spear, Buffalo, N. Y.
CIVIL ENGINEERS' SOCIETY OF ST. PAUL.
Oct. 2. Secy., C. L. Annan, City Engineer's Office.

ENGINEERING NEWS

AND

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ADVERTISING RATES: 20 cents per line agate measure. Schedule sent on request. Changes of advertisements must be in hand on Monday afternoon; new advertisements, Tuesday afternoon; transient advertisements, not later than Wednesday noon. The last pages go to press early on Thursday. We shall be obliged if subscribers who fail to receive their papers promptly will notify us without delay.

Many phases of water-works construction and operation will be discussed at the annual meeting of the New England Water-Works Association, at Worcester, June 14 to 16, inclusive. The program (see Eng. News, May 25) promises interesting and valuable information regarding, among other things, pumping machinery, pipe casting and coating, water main trenches, meters, anchor ice, water purification, a stand-pipe, covered reservoir, large steel intake, water supply system and the work of a large hydraulic laboratory. The authors of the several papers are exceptionally well qualified to handle the subjects assigned to them, and an exhibit of water-works appliances has been arranged for, and the usual number of pleasurable visits to manufacturing establishments and other points of interest have not been forgotten by those in charge of the meeting. As we have stated in connection with previous conventions, attendance at this one will be time and money well spent on the part of all who are directly or indirectly interested in water-works, especially superintendents, secretaries and members of water boards.

One of the outcomes of Mr. Robert E. Peary's new Greenland expedition is to be a more extended and systematic series of observations on the local distribution of the aurora and its relations to electro-magnetic conditions of solar origin. These observations will be under the direction of Dr. M. A. Veeder, of Lyons, N. Y., and he is now forwarding to all those who wish to assist in this work blanks for the recording of observations made at specified hours each day. These blanks and all information desired will be forwarded to individual observers as well as to solar and magnetic observatories, and it is thought that the identification of the precise solar conditions on which the aurora depends in any given instance is already possible and will be made certain by these widely spread and systematic observations. Mr. Peary, for his part, will occupy a station at or very near 77° 30' north latitude and 70° 15' west longitude, and the arctic records will be continuous whenever observation is possible, as relays of observers will be provided. It is hoped that every one interested in the various phases of this subject will assist in this useful work.

Dr. Veeder tells us that, contrary to his original expectation, the men who are taking the most lively interest in these observations are the engineers and surveyors of the country, rather than those men simply engaged in astronomical studies. This is not so strange after all, for there is an eminently practical side to this systematic study of auroral, or magnetic, phenomena. The officers of the United States Coast and Geodetic Survey are especially interested in these observations, and that department of the government will furnish all necessary instruments in the cases where these are required. These officials hope that some general law, or laws, may be deduced that will explain certain puzzling entanglements and deviations observed in certain parts of our country in the line of equal magnetic declination, for the attempts to ascribe these deviations to local, metallic sources of attraction have utterly failed. They seem to be most powerful at the mouths of great rivers, such as the entrance of the St. Lawrence into the Gulf of that name, where the line of equal declination is very much tangled; or near the entrance of the Ohio into the Mississippi River. In the latter case the line passes from the Gulf almost parallel to the larger river until it approaches the Ohio; it is then suddenly deflected in a great loop toward the east and again returns to the Mississippi north of the Ohio. The law controlling this observed and decided influence of great bodies of swiftly flowing water upon the force and direction of magnetic currents is as yet unknown; and it would seem probable that a similar, or even greater, force would be exerted by the great ocean currents. The systematic study of these phenomena and the intelligent attempt to gather data upon which to found a general law is thus evidently very far-reaching, and the conclusions ultimately arrived at may be of the greatest importance in solving other phenomena controlling our globe and its connection with the central source of all light, heat and power. The Weather Bureau is also specially interested in these recorded observations of the aurora in connection with the local distribution and mutual relation of thunderstorms. This bureau has issued instructions and appointed observers, who will act in conjunction with volunteer observers and established solar and magnetic observatories scattered over the world.

Accidents at grade crossings of electric and steam railways are beginning to attract attention to the importance of restricting such grade crossings as much as possible, and protecting those which are absolutely necessary by some more reliable system than the old plan of having the conductor run ahead, which has sufficed for the horse cars. The electric cars are much heavier, carry a greater number of passengers, run at higher speed, and are liable to be stopped on the track by the trolley getting off the wire at the break. Yet in no state, so far as we now recall, is there anything to prevent the continual establishment of new danger points of this class through the change of horse railways to electric and the building of new electric roads on established highways. On the railways entering Boston this evil has become especially serious. On the Old Colony R. R. there are 22 grade crossings of electric lines, and on the Boston & Maine system there are 40. The officials of steam railways have no power to do more than protest against the multiplication of such crossings. They may be established wholly without their knowledge or consent. The matter has already been made the subject of a legislative inquiry in Massachusetts, and might well be taken up in other states. It furnishes an additional and strong reason for the elimination of highway crossings at grade; but where this is deemed impracticable, and a grade crossing of the two tracks is absolutely necessary, the safest plan would seem to be the establishment of automatic signals, connected with derailing switches, to prevent any electric car from attempting the crossing when a railway train was anywhere near on either side. We believe automatic signals are in use already at a few electric railway crossings, but nothing like a general adoption of them has been made and is not likely to be until the law steps in to order it on behalf of the public, whose lives are at stake.

We describe elsewhere in this issue a new method of raising water by the direct action of compressed air without mechanism of any sort save a vertical column of ordinary pipe, open at top and bottom. The practical value of the system appears to be such that it is surprising it has not before been developed and brought into general use. It might naturally be supposed that the efficiency of such a system would be very low, but, on the contrary, theory and experiment together have proved it to be capable of a remarkably high degree of efficiency. The advantages of a system which aerates the water as it lifts it, and which, from the absence of all mechanism or moving parts and its very small cost, is admirably adapted for lifting water charged with sand, grit, or corrosive substances, are so evident that they need only be mentioned.

As examples of the practical applications of the system, we may mention that at the Wayne, Pa., water-works a single air compressor is pumping from 12 artesian wells, located over 2,000 ft. apart, and has doubled the flow from them. At the mines of the Colorado Central Consolidated Mining Co., near Georgetown, Colo., water is raised on this system by a series of lifts to a height of 250 ft. A number of manufacturing establishments at Newark, N. J., have large wells operated on this system, one of them (the Celluloid Co.) raising 1,000,000 gallons daily from three 8-in. artesian wells.

We have referred to the system as new, for it has been in commercial use only a few months. Its invention, however, dates back at least 13 years, and there is some evidence that it was used at a much earlier date. The operation of the system involves only familiar principles, but they appear in such a new guise that the discussion of the theory of the system, which is elsewhere presented, will be found very interesting.

We would also call attention to the ingenious application of the same principle in compressing air, the result being an air compression system working on absolute isothermal lines and with no moving mechanism whatever save a column of water flowing downward in a vertical pipe. The efficiency and small first cost of this system also make it deserving of careful study by engineers.

THE IDEAL ENGINEERING SCHOOL.
V.

In considering the details of any professional course we need to remember that the purpose of that course is not education in the abstract, but primarily to train men TO SUCCEED, in the given profession, and still more particularly to train them to succeed during the first six or eight years after graduation, or, perhaps, we might even say, during the first half of that period. After that, the man's further progress depends chiefly on himself, on what he has learned since graduation and on the general character which his education and early experience has given him. He retains little of the specific fragments of information which he acquired at college except as he has had occasion to renew and strengthen them since.

What, then, does the engineer require most to smooth his path during the first three to eight years after graduation? The answer is not doubtful. Unlike the three older learned professions, there is in engineering, a certain broad and simple field for juniors and men merely in training, these latter being far more in number, quite as necessary and yet with duties quite different in nature from that of the comparative few at the top of the profession. The young man who is well fitted for this junior work at graduation, drops on his feet at once—an advantage which is not paralleled in the three older professions. Therefore, the prime need of the young graduate in engineering, to avail himself of this exceptional chance for getting a good start, is not to know a little of everything, but to know how to do a few simple things well; to be a capable and zealous subordinate, to be apt for "team-work" (to use a term which every one understands), so that he may manage a party well, and to commend himself in that capacity to the superiors who have his future in his hand. To this end, as we have already seen, he needs, almost more than he needs anything else, to be trained to the utmost in habits of command and of obedience, of courtesy, self-restraint, fidelity and truthfulness, which are the life-long need of the "Captain of Industry" as they are of any other captain of fifties or hundreds and ten-thousands. But we are no longer directly concerned with these,

but with the studious side of the engineer's training. We mention them again only because we are about to show in part how training in these qualities might be combined more than it is with scholastic training.

The specific bits of knowledge which the young graduate most needs at graduation may be listed thus:

1. A practical hand in pencil drawing of all kinds, whether for designing or mapping, and using this term in distinction from the artistic or fancy kinds of drafting, which are becoming largely a separate specialty, and very properly so. The young man who hopes to become an engineer may easily have too much of this artistic aptitude for his own good. Nevertheless, he needs also:

2. A practical hand and eye in off-hand quick lettering, which will stay by him through life; and a certain neatness of hand which has become instinctive in doing quickly such simple drafting work as making profiles and the like, with such combined quickness and neatness as to make him rather a marked man.

3. He needs a marked and special aptitude for doing ordinary computing work, addition, subtraction, multiplication and division, quickly and well. No one but a bookkeeper, and hardly he, has so great a need through life to have this mechanical faculty highly developed and highly trained as the engineer. He deals with concrete facts, not abstractions, and facts are chiefly ascertained or gaged by figures. The bookkeeper does more figuring, but it is within narrow range; and the very fact that he is continually doing it, soon gives him all the capacity that practice can give, and so it matters relatively little whether he starts in with this acquired faculty or not. The engineer's need for good computing capacity is more like the frontiersman's for his pistol. He does not want it so often in a day or week or month, but when he does want it he wants it—bad, and wants it in all sorts of ways. Therefore, the ideal engineering school will make a special effort to develop this faculty, more than is made in any other kind of school whatsoever.

4. He needs a like ingrained training and facility in using the elementary rules and methods of algebra, geometry, trigonometry and (in less degree) analytical geometry. The abstractions or higher departments of those sciences concern him not at all. In no strictly professional work will he ever have occasion to use them; or if by chance he does, he can "tone up" for the occasion easily enough; but the elements of those sciences through all his life to come he needs to have as familiarly at his finger ends as his A B Cs. To this end he needs a like familiarity with the use of logarithms, with the use of the slide rule, and with the general methods of representing facts graphically. It is a discredit to any engineering school to graduate a bright man who is ever again at a loss to use logarithms or to solve a right-angled triangle after long disuse, or to evolve from his inner consciousness off-hand the formulas for solving any triangle, or at least most of them, or quite a list of other simple things of this kind. If there be any engineering school now existing which does turn out its men thus schooled in these simple things, we have not happened to meet any of its graduates, though we have met in our time many graduates of many schools.

5. (Perhaps this should have been mentioned first). He needs—and very badly needs to get along fast and well, through the junior grades—to be a thorough master of instrumental field-work, by which we mean that he shall be able to take any position on any kind of surveying work, from chief of party down, and be able to do its work with that easy facility which comes only from practice, and much practice, not only in doing things himself, but in pursuading or compelling others to do things in a regulated, synchronous and effective way; in other words, he needs to have been trained to be a leader of men as well as a doer of things. In saying this we have most directly in view the needs of the "civil" graduate, as in the oldest, and still, perhaps, the leading department of engineering work, but for several reasons the same need for the same training, or for a strictly analogous training, extends to graduates in any department of engineering.

Now, instrumental field-work is very much like playing on the piano. It is not a science, but an art; an art acquired only by long practice; and to be a passable master of field-work requires even longer practice than to be a passable master of piano-playing. The theoretical side of either (except for recondite specialists) may be taught almost as briefly as Hamlet taught playing on the flute: "Govern the ventages with your fingers, thus, give it breath with your mouth, and it will discourse most excellent music." But the skill which distinguishes the master from the tyro is an indescribable thing, to be appreciated only in results, acquired insensibly by practice only, the learner knows not how, and refusing to be set down in words. There is, however, as vast a difference among practioners of field-work as among piano-players, and the proportion of passable masters to the bunglers in either art is about the same. Each art also has about an equal need to be taught only by a real master, and by repeated, persistent lessons if the average pupil is to make much progress. In each a natural aptitude goes a long way, but an excellent imitation of natural genius may be produced by persistent practice under a good master, and in that way only.

Few of our professors of engineering, and not one of our college presidents whom we can recall, have had practice enough to be themselves masters, in any proper sense, of instrumental field-work, and consequently few of them duly realize how much there is to the art, how greatly the young engineer gains by being skilled in it, how useful the knowledge is throughout his life, and how sadly a majority of engineers fall short of real skill in it. Skill in it consists far less in personal knowledge than in qualities of leadership, in licking a whole party into shape as a team, in a certain quick foresight as to what to do next, in a certain acquired and instinctive grasp of how to deviate just enough and not too much from the methods of strict exactness for the particular end in view, and in knowing at once just what is the best method of doing so.

We shall show shortly that this kind of instruction is greatly neglected at even our best technical schools, which is the more to be regretted because the "graduate of the axe" is apt to be an even worse bungler in it. Like the self-taught piano-player, he does pretty well "considerin'," and there is an occasional Blind Tom, but they are the rare exception.

The present writer's deliberate judgment, formed after as great opportunities for observing young men in science as many men ever have, is that the average young graduate at the present moment is losing from two to three years' time in his start in life by the unnecessary and improper neglect of our engineering schools to give due drill in the five elements numbered 1 to 5 above; and the bright ones are losing even more than the dull ones. This instruction, in the writer's judgment, might be given just as well as not, if only the desire and comprehension of the need were there, not by curtailing in any way the quantum of scholastic instruction now given, but simply by recognizing that the above specifications relate chiefly to matters which are rather a relief from than an extension of the scholastic work proper, and hence may easily be added on to the course by utilizing the third or less of the year which is now thrown away in long vacations which (for the most part) have an injuriously relaxing effect on men in training to become engineers.

If so, the grounds for this belief are at least worth making clear. It is supported by the analogy of military training, which we have seen to be a close one; and to pursue that analogy still further by changing from our last analogy, acquiring skill in practical engineering field and office-work is much like acquiring skill in military drill—except that it takes more drill and is far less purely mechanical, so that it is easier to make intellectual young men thoroughly enjoy the process. Teaching tactics as field-work is taught in our engineering schools, all there is to it can be taught in a few lessons. The cadet can go through every motion after a fashion very soon, but how ridiculous would be that military school which should confine its instruction in tactics to merely going through the motions after a fashion, never drilling them enough to do it well, and to teaching its future officers the private's duty only, never taking any pains to train them to act as officers, never giving them any continuous imitation of the practical life of the soldier or officer, never training them to command themselves and others without the aid of a professor, giving purely scholastic instruction for five days in every week, drilling them after a fashion on one day of each week only for a part of each year, and when the elastic limit for scholastic instruction had been reached (or alleged to be) turning them loose to "play tennis or loll about the seashore" for a third or so of each year?

Not thus is the good military officer made. Not thus is the good engineer to be made. On the contrary, our military schools recognize that it is an aid to getting the maximum of intellectural work out of their students (as they do) to vary the monotony of every day with a modicum of routine exercises, not taxing the brain power, but cultivating quickness and aptness of mind and body. By thus devoting part of every day and the whole of the summer vacation to this routine drill in things that can only be learned by routine, they not only succeed in including in a four-years course rather more intellectual work than any of our civil schools, but they teach thoroughly a host of things besides, even more necessary to the future soldier, simpler to tell about but really harder to acquire.

For lack of a like drill to this for developing like faculties our present engineering students are suffering a loss which, to any one who believes in its existence, is painful indeed to contemplate. They are getting but half of what they might get from their four-years course, and that half in a practical sense the least important and essential part—mere book knowledge of theory and book knowledge of practice, or but little more than that. And the pity of it is the greater, because to a very large extent the lost ground cannot be regained. When the student graduates the man is born; he can rarely indeed be born again. If a bright student he might as well as not be turned out a finished chief of party, or the equivalent in other lines, or both, such as he will not otherwise become by ten years of purely practical work. He too often does come out a man fit only for the most subordinate duties until after two or three years' of practice to give imperfectly what he might have learned better in his college course, besides all he did learn, viz., discipline of his character and practical aptitudes.

Not forgetting that there is some steady progress in this direction, we will now endeavor to determine by taking up the features of the course separately what yet remains for the ideal school to do in each beyond what the real schools now do.

AMENDMENTS TO THE INTERCHANGE RULES.

The usual crop of proposed amendments to the "code of rules governing the condition of and repairs to freight cars for the interchange of traffic" has been gathered from the several railway clubs; and it may be safely prophesied that two days, more or less, of the Master Car Builders' convention next week will be spent in discussing these proposed changes, the most of which, it is equally safe to prophesy, will be finally rejected by an overwhelming vote. The reasons why sentiment in the M. C. B. Association is strongly against changes and additions to the interchange rules are, first, that the rules are already too complicated and require too much of the car inspectors; second, that every new rule or every change in the rules must be gradually "worked into" the whole force of car inspectors, upsetting previous practice to a greater or less extent and giving rise to conflicting interpretations, and, third, that by long experience it has been found that amendments and additions to the rules often work in a way which those who projected and advocated them never foresaw. The majority of the members of the Association feel, if they do not say, that it is better to bear the ills we have than fly to others that we know not of.

But, notwithstanding this general prejudice against innovations, every change which can be clearly shown to the members of the Association to carry real gain and nothing of loss with it can be carried by a good vote.

The most important changes to be considered at the coming meeting are those which refer to the much mixed question of drawbar repairs. According to the rules at present in force, a drawbar of the M. C. B type may be replaced with any other

M. C. B. bar, provided it is of design and dimensions which do not impair the strength of the car. When such a change is made the uncoupling arrangements must be made operative, and if the attachments at the rear end or the uncoupling arrangements are altered, the party making the change is responsible for the cost of changing back to the original standard.

The chief trouble with this rule appears to be that some companies have followed the practice of replacing broken M. C. B. couplers with ordinary link-and-pin bars, and under a rule adopted last year they receive from the owner of the car a credit for the full value new of the link-and-pin bar, when the car reaches home and the link-and-pin coupler is removed. Of course every road has lying about its shops and yards more or less odd patterns of link-and-pin drawbars, and the opportunity to get rid of them at full value has been too good to be lost. This is one of the cases where a change in the rules has shown results in practice which were not foreseen at all by those who voted for it. It has in effect caused heavy expense to the owners of cars equipped with M. C. B. couplers, and has put a premium on the practice of making drawbar repairs with wrong material. It seems altogether probable that this objectionable rule will be amended by the convention so that owners of cars will pay for wrong drawbars at scrap rates as for any other wrong material.

Concerning the replacement of broken link-and-pin bars, there is again a movement to simplify such repairs by making it allowable to substitute any pattern of link-and-pin bar for any other link-and-pin bar when broken, without being obliged to card the car for wrong material. The argument in favor of this is certainly a strong one. According to the law passed by the last Congress all these link-and-pin drawbars must go to the scrap heap in a few years anyway, so what is the use of spending many thousands of dollars every year to keep up each road's standard link-and-pin bar. Surely it would be for the best interests of all to stop spending money in this way and adopt the simple rule that any road breaking a link-and-pin bar may put in its place a bar of whatever style is most convenient. It would be a still greater piece of economy if every company would put only M. C. B. couplers on cars with broken drawbars, no matter whether the car was a home or a foreign car, charging the cost to the owner in the latter case after deducting the value of the broken link-and-pin bar.

Both these reforms are bound to come, sooner or later, and many progressive railway officers recognize the fact that the sooner they are adopted the better will it be for the exchequer of the railway companies. At the same time it is extremely doubtful whether even the first of these reforms can be carried at this year's convention.

There are still many companies which are wholly blind to the progress of affairs, and seem bound to keep on without regard to what others around them are doing. For instance, one large Western road, which has, to say the least, never been noted for its progressiveness in mechanical matters, is now buying link-and-pin drawbars of cast-steel by the thousand for application to its cars. When such examples of "pound foolishness" as these exist it is well not to expect too advanced action on the part of the railways as a whole.

Another reform which has been more or less agitated during the past year is the restriction of the limits in gage of wheels. A paper by Mr. Godfrey W. Rhodes, published in our issue of Feb. 2, 1893, first called attention to the remarkable oversight by which for many years a variation of ¾ in. has been permitted in the gage of car wheels without regard to the damage and danger due to the passage of wheels wider than 4 ft. 5½ ins. through frogs and switches. The M. C. B. standard to be followed in mounting wheels is 4 ft. 5⅜ ins., and ⅛ in. variation each way is allowed. Why any greater variation than this should be allowed in service it is difficult to see; and there is much to be said in favor of making the limits in the interchange rules the same as those adopted for use in the shop. But at least the proposition to stop these wide gaged wheels ought to be carried without a dissenting vote, in the interests of both safety and economy.

Mr. Rhodes also recommended in his paper that a limit should be set to the thickness of wheel flanges, and his reasons for this are strong and convincing to anyone who will give the matter careful study. Nevertheless, it would probably be impossible to place a limit to wheel flange thickness in the interchange rules. Traffic officers and general managers are disposed to grumble already at the delays of freight due to car repairs, and to stop a car with thick flanged wheels is something to which they would not listen, notwithstanding the danger which can be plainly shown to exist in running such wheels.

As respects the wide gaged wheels, the New York Railroad Club has recommended that the allowable width be reduced to 4 ft. 5½ ins., a reduction of ¼ in., but even this small but very important change, it is to be feared, may not receive the attention which it deserves. It is in some respects fortunate and in others very unfortunate that in the Master Car Builders' Association the motion "that the rule stand as it now is" is the motion which usually prevails in the convention.

The Massachusetts smoke prevention law, which takes effect July 1, applies only to Boston, being limited to cities of over 300,000 inhabitants. The law provides that no person shall in such a city after July 1 use bituminous coal for steam making, unless the furnace is so built or equipped that at least 75% of the smoke is consumed, "the degree of suppression being determined by the quantity of such smoke emitted, as shown by the density and color of the issuing smoke and the length of time which it is visible, the maximum standard of comparison being a continuous discharge of dense, dark smoke during the time the furnace is in active operation."

An officer charged with the enforcement of the law is to be appointed by the Mayor, and a penalty of $10 to $100 is fixed for each week of violation.

A competitive test of small caliber, rapid-fire guns, the first to be made, is ordered by the Chief of Ordnance, and is to be held shortly at Sandy Hook. The Hotchkiss, Driggs-Schroeder and Seabury guns will certainly enter the contest, and it is expected that the Sponsel gun, that did such good work recently at Indian Head, will also be entered. A total of 1,500 rounds will be fired under varied conditions. To determine velocity five rounds will be fired from each gun, and ten rounds are to be fired at 1,000 yards, one mile and 3,000 yds. for accuracy. Rapidity will be ascertained by the number of rounds that can be fired in five seconds, three trials with each gun; also by the number of rounds that can be fired in one, three and five minutes, respectively. Finally the time required to fire 100 rounds, during which operation the condition of the gun as regards heat, ease and cetainty of action is to be carefully observed. Rapidity with accuracy is an essential to the success of a gun, and this will be determined during the trials by firing 30 aimed shots at varying ranges. During the tests the mechanism of each gun is to be exposed to uniform blasts of fine dust, after which 20 rounds are to be fired. This is a necessary practical test. Defective cartridges and others with excessive charges will be employed to test the strength of the breech mechanism of each gun. With excessive charges the pressures will gradually increase until that of 45,000 lbs. per sq. in. is, if possible, attained. Additional tests thought necessary by the board as a result of circumstances developed during the trials may be made. Great fame and a considerable amount of money await the victorious gun.

The alleged rich asphaltum deposits of the Uncompaghre Reservation, in Utah, have become the subject of hot contention. The American Asphalt Co. had succeeded in obtaining from the Indians an agreement to lease the lands, but Secretary Noble refused to ratify the deal, because he believed the agreement would give the American Asphalt Co. an absolute monopoly on the public lands of the United States. This reservation, he said, was not set aside, under the executive order of Jan. 5, 1882, as a permanent reservation for the Uncompaghres; these lands had not been ceded to them, and the Indians cannot make terms with a third party for anything contained in them. The reservation covers 1,933,440 acres, and the Indians upon it number 988, and 200,000 acres would answer all purposes of allotment of land to them. The portion including the asphaltum deposits is rough and mountainous, and unsuited for agricultural purposes, and Secretary Noble suggested the proclaiming of this land as part of the public domain, and subject to occupation under the mineral laws. The change in administrations left the case there.

The Milky Way is being photographed by Professor Barnard, of the Lick Observatory. He has been engaged in this work for several years, and three years more would probably elapse before he is done. But he says that when the plates are all finished, it will be found that there will be in this bright belt nearer 500,000,000 than 20,000,000 suns, as the textbooks now declare.

LETTERS TO THE EDITOR.

MITER JOINTS FOR RAILS.

Sir: Can you give me any information as to the results in the case of, or experiments with, beveled or mitered rail ends, at joints? In giving me this information through the columns of your valuable paper or otherwise, you will greatly oblige,

Yours truly,

Wm. T. Gould, Resd't Engr., T. C. R. R.

Waco, Tex., May 23, 1893.

(This arrangement is in use to some extent on the Manhattan Elevated Ry., and has also been used on the Lehigh Valley R. R. for some years, where it is said to have been very satisfactory. There is absolutely nothing in this device. The theory on which it is based is false, that the joint comes from the little break in the continuity of the surface. It does not come from that at all, but from the elastic yielding of the rail ends, which is not helped in any way by the mitering of the rail ends. Some people have imagined they saw some good from it, and some have not. It is hardly possible that any real and sensible benefit can ever have been observed.—Ed.)

SWITCH ACCIDENT ON THE CENTRAL VERMONT R. R.

Sir: I was a passenger on a special train following the one derailed by a misplaced switch, at Roxbury, Vt., on line of the Central Vermont R. R., early on the morning of May 31, and believe it a duty to call the attention of the public to the circumstances. It was a misplaced switch, but it was the old-fashioned stub switch, with no safety appliance whatever. The switch was set for the siding, and nothing remained but to go on to the ground. All that saved the section following from telescoping the first was the necessity of stopping at Roxbury for water, as that section had run from St. Albans to Roxbury closer than could be done with safety. The Central Vermont R. R. is now doing a heavy passenger business, and unless more stringent rules are enforced governing the interval between trains there will be trouble. No road is excusable for using such switches in the main track at the present day. In this case one life was lost, but in the next it may be 100, as nothing but luck prevented its being 100 this time. Railroading, as practiced on the Central Vermont R. R., is not railroading.

Yours truly,

June 2, 1893. B.

(This is one of the many cases illustrative of the dangerous discrepancy in the relations of track to train service.—Ed.)

THROTTLING A SIPHON TO PREVENT AIR-LOCKING, AT MONTCLAIR, N. J.

Sir: I read with much interest the description in your issue of May 4 of the method employed for delivering water for Mount Vernon, N. Y., through a 12-in. siphon, and also the arrangements for charging the same when air-locked.

Having gone through an experience of the kind, although with only a 3-in. pipe, the result might be interesting to your readers. In the plant that I had charge of in Montclair, N. J., five artesian wells were sunk for an additional supply to a depth of 100 ft. These were connected at about 4 ft. below the surface into one discharge pipe which had a slight fall towards a large wall about 250 ft. away, where there was a vertical drop of about 22 ft., forming the lower leg of the siphon. The height of the water at delivery varied from 4 to 15 ft., according to the season, below the surface of the ground, which was practically level in the neighborhood.

At the outset of the work arrangements were made for charging the siphon, and also for withdrawing the air, but after experimenting for a brief period, I found that by throttling the discharge at the lower end of the siphon the necessity for charging periodically disappeared.

The throttling was effected by putting in a bushing and reducing the pipe from 3 to 2½ ins. diameter for the last 2 ft. in its length. The result has been that for 3 years we have had no occasion to charge the pipe at all, except when the supply has been cut off and stopped.

The theory of the thing, to my mind, is that the velocity in the lower vertical end of the siphon being naturally greater than through the horizontal stretch, the stream consequently becomes attenuated and allows the air to crawl up by checking the bottom flow till a condition arises that the pipe is always full, that trouble ceases, and what air is inherent to the water is carried on by the velocity. Jas. Owen.

Newark, N. J., May 25, 1893.

(The theory advanced seems plausible. The operation of siphons is often more or less bothersome, and we shall be glad to present other experiences in this connection.—Ed.)

THE NIAGARA RIVER DISCHARGE CURVE.

Sir: In view of the importance of obtaining unquestionably accurate discharge measurements of the Niagara River, it would seem desirable to have on record more information bearing upon the results obtained by Mr. J. C. Quintus. The anomalous character of the discharge curve shown on page 197 of Engineering News, March 2, 1893, has been noticed by many readers, and attention has been drawn to it by letters from Mr. George Y. Wisner in the issues of March 9 and May 11. The published curve is so extraordinary and leads to results so contradictory to all previous experience that the matter deserves most careful scrutiny.

There are perhaps two points open to criticism. The first of these is in the use of a single current meter in measurements of such importance. Great care seems to have been taken in all minor details, but the value of the results depends solely upon one meter, an instrument which at best can yield only approximate results. The fact that the readings of the meter when used under similar conditions did not differ by a notable per cent. can hardly be accepted as conclusive proof of its accuracy. Had the results been in any manner checked by a second instrument, especially one of different make, where the same class of errors would not arise, the measurements could have been received with greater confidence.

The second criticism arises from the method of constructing the discharge curve by means of equations of the form $y = S + Tx + Ux^2$, etc. While such methods are of the greatest value in most discussions of data, their application to results of this kind tends to obscure some of the limiting conditions and to give an unwarrantable confidence in the results. In the present case an inspection of the plotted observations shows that the curve derived by Mr. Quintus is governed very largely by a single observation, that made at the lowest point on Dec. 24, 1891. Were it not for this single point, which stands by itself, being 0.6 ft. below the nearest point, the curve would become practically a straight line or would assume a normal shape. By the use of the mathematical equations this one observation is given almost as much weight as the rest of the work put together.

It should be noted that the measurement of Dec. 24, which so largely controls the discharge curve, and renders it abnormal, was made at a time when the river was rapidly falling, having been at a height of 1.17 on Dec. 22. This fact does not seem to have been taken into account nor any allowance made for the effect of the unusual fluctuation which brought the water down to the point reached on Dec. 24. Had the engineer in charge of the fieldwork plotted the results and worked out a discharge curve by graphical methods, he could hardly have failed, knowing the circumstances in each case, to have assigned different weights to the various observations and to have sketched a curve which for practical purposes would be far more valuable than that obtained. The devotees to mathematical formulas can hardly be expected to admit that this is the best method, but engineers who have had a continued experience with current meters will generally admit that, considering the nature of the data to be discussed, this is by far the fairer way.

It will probably be admitted by all that when measurements of the Niagara River have been made at high stages the final curve of discharge must be normal—that is to say, in the reverse direction to that published—for the river cannot continue to rise and increase its cross section indefinitely without soon having a great increment in its rate of flow. Such being the case, it would seem to be an entirely proper assumption to make that the observed points must ultimately lie along a line nearly straight or curving upward toward the right, and that the points which will not fit into this scheme are open to suspicion. In other words, it would seem more proper to employ reason and analogy in interpretating these observations than to follow blindly wherever mathematical equations may lead. F. H. Newell.

Washington, D. C., May 31, 1893.

THE METROPOLITAN ENGINEERING BUREAU.

Sir: The Metropolitan Engineering Bureau, 54 Stone St., N. Y., advertised in your journal, must be, I think, a myth. I sent them an application with inclosure, some time ago, and not being able to hear from them, went there a few days ago. Found no office, but learned that a Mr. F. J. Alexander had been in charge and had left. If the thing is a fraud you would do a service to engineers by looking it up.

Yours truly, Engineer.

(Concerning the above we can only remark as follows: The bureau made fair representations to us as to its aims and prospects, and prepaid six insertions of the advertisement referred to. But since receiving the above letter we find the office apparently permanently closed and the present address of the bureau unknown. Under these circumstances it is hardly necessary to advise engineers to keep their money in their pockets, as far as this bureau is concerned.—Ed.)

THE PROFESSIONAL STATUS.

Sir: The profession is at present deeply interested in the questions of ethics, status and professional practice; the American Society of Civil Engineers will probably give a deliverance on the subject at an early date, the question will undoubtedly crop up at the Engineering Congress in Chicago, and the Canadian Society of Civil Engineers has also the subject under consideration. In addition to the two larger societies named, there is a great interest taken and much discussion going on among the members of the various engineering clubs scattered over the United States.

I have been elected chairman of the special committee of the Canadian Society of Civil Engineers on professional status. I have the pleasure of receiving much support from numerous correspondents in all parts of the continent. I take the liberty of asking you for the use of your columns to make known to your readers my desire to receive from them expressions of opinion upon the movement.

My committee will report in November, but I mean to bring the matter up before the Convention in Chicago, and for this purpose will be glad to receive the views of as many engineers as may be disposed to let me have them. Respectfully,

Toronto, June 1, 1893. Alan Macdougall.

NOTES AND QUERIES.

"A" asks us to "define as simply as possible the term 'train-mile' as used in Wellington's 'Economic Theory of the Location of Railways.'"

The term is one of universal use and almost defines itself "Per train-mile" means per mile run by a train, which ordinarily means a combination of one or more engines with one or more cars. There are many kinds of train, and hence many kinds of train-miles, which must be specified to distinguish between them, as revnue, freight, passenger, etc., train-miles. To cover cases of engines running alone the engine-mile unit is also used, and this again may be either actual or construction, to cover work in switching, etc.

F. A. S. inquires if there is such a publication as a complete list of the U. S. Government publications pertaining to engineering subjects. There is such an index of government publications, but not having a copy at hand we can give no information as to its treatment of engineering subjects. A letter to the Librarian of Congress, or to W. H. Lowdermilk, dealer in books of this character, Washington, D. C., would secure the required information.

THE AIR-LIFT PUMP.

If an open pipe be sunk in a body of water and air be forced into its lower end, what will occur? This is a question which has been asked and answered by several inventors and engineers, and the upshot of their questions and investigations has been the development of an absolutely new type of pump, which has already had sufficient use to prove its practical efficiency and value, and which promises to take a place of no small importance in hydraulic engineering.

The theory of this pump's action is so necessary to an understanding of the "state of the art," as well as the history of its development, that a brief discussion of it must be made at the outset.

Returning to the question stated above, if an open pipe as A B, Fig. 1, be sunk in a vertical body of water and air be forced into its lower end, experiments have shown that the water will be raised in the pipe.

Why is it thus raised? The first answer ascribes it to ejector action; the entering air current by its friction against the water carries it along with it. Of course, this is a familiar principle; every ejector pump, of which thousands are in use, illustrates it. But while ejector action may aid in raising the column of water in the air-lift pump as actually operated, experiment has fully proved that it is not an essential or important feature in the pump's operation. It has been found that when the air is not forced into the bottom of the pipe, but is merely allowed to escape, that the water is raised in the pipe, and the question recurs, What causes this raising?

The first answer to this question, and a perfectly correct one, although it may not at first appear satisfactory, is that the rise of water in the pipe is due to the lessened weight in the pipe due to the space occupied by the air bubbles. Thus, suppose the pressure at the mouth of pipe A B due to the head of water outside to be 6 lbs. per sq. in. Now, if the air bubbles inside the pipe A B occupy one-third the space and the water occupies two-thirds the space, then the pressure at the mouth of pipe A B due to the weight of water inside it will be only 4 lbs. per sq. in. Of course, the water will rapidly flow into the pipe under these circumstances.

"But," answers the Objector, "that is not sound physics. The pressure of water depends not on the quantity, but on the total head. A stand-pipe may be only a few feet in diameter, but the pressure due to its height will extend over a system of distributing mains miles in extent. In this case, suppose the bubbles do fill one-third the space and are of any size from as large as peas to the size of billiard balls, if you choose. Then will not there be a continuous passage for the water to pass downward between the bubbles, so that the water at the very top of the pipe can exert its pressure downward to the bottom? How then can the pressure be any less at the base of the pipe from the water inside than it is from the water outside?"

Certainly, Objector's argument does appear plausible; but let us throw the burden of proof on him. "Experiment has fully proved," Objector, "that the water does rise in the pipe, and rises with good force and volume, too. Now, if your theory is correct, how do you account for that?"

After considerable study Objector announces that he has found two ways in which the water may be raised in the pipe in accordance with his theory. "The specific gravity argument is all right, I admit," says he, "under certain conditions. Suppose the bubbles in the pipe are very fine, so that

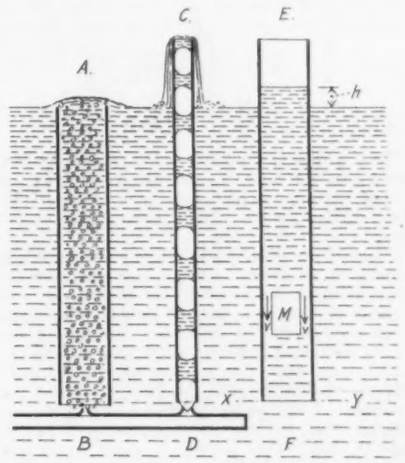


Fig. 1. Diagrams Illustrating Action of Air Lift Pump.

they cannot rise freely through the water, but are entangled with it, and we have really a mixture of the two fluids, air and water. The specific gravity will indeed then be less than that of the water outside, and the water will rise because the interstices between the bubbles are too small for the water to flow down between them and exert its full head. Or, on the other hand, if you will go to the other extreme, and pass in air bubbles so large that they completely fill the bore of the pipe, then you will have alternate layers of air and water, as in the pipe C D. In this case again the water at the top of the pipe is shut off from communication with the lower end and cannot exert the full hydrostatic pressure there, due to its elevated position."

Objector's reasoning again has some truth in it. It is certainly the case that either with very large bubbles filling the bore of the pipe, or with very small bubbles, the water will rise in the pipe. Can it be proved that the same thing will occur with bubbles of any size or number?

In the pipe E F, suppose the body M is placed. It may be a bubble, a piece of cork, a closed can—anything displacing a certain bulk of water and of a weight so small that it may be disregarded. Suppose, first, that the body M is attached to the pipe and thus prevented from rising. Then the pressure on a plane x y across the mouth of the pipe will be as great from the interior as from the exterior, notwithstanding the volume of water displaced by the body M. We are so accustomed to accept this fact, which the old text books on physics used to call the hydrostatic paradox, that we sometimes forget the reasons which lie behind it. Why is the downward pressure on the plane x y not lessened by the weight of the water which M displaces? Because the body M is buoyed upward by

a force equal to this weight, that is to say, it exerts a reacting force downward upon the water of this amount, and thus just offsets the weight of the water which it displaces.

Evidently when the conditions of the case are altered and the body M is allowed to ascend, it can no longer exert a lifting force upon the pipe, neither can it exert a reaction downward upon the the water, except as friction and inertia retard its upward movement. Thus the total pressure downward on the plane x y will equal merely the weight of the water in the pipe and will be less than the pressure due to the head by the weight of water displaced by M.

A very neat demonstration of the theory of the air-lift pump is sent to us by Prof. Elmo G. Harris, of the University of Missouri School of Mines. When the body M rises in the pipe by virtue of its specific gravity, the water in the pipe must flow down past the body with a velocity which we will call v. Where is the head to create this velocity?

Let O = volume of body.

S = distance through which body rises in a given time.

W = weight of unit volume of water.

A = area of cross-section of pipe.

The buoyancy of the body = W O, and in rising a distance S it does work = W O S, which work is found in the downward velocity v of the water past the body (provided the water cannot rise so high as to flow over the top of the pipe). Then

$$W O S = W A S \frac{v^2}{2g}$$

$$\frac{v^2}{2g} = h = \frac{O}{A}$$

That is to say, the head which causes the flow down past the body M, and which measures the rise of water in the pipe, equals the volume of the body divided by the area of cross-section of the pipe.

If any of our readers still fail to understand how bubbles of air rising through a pipe can raise the water in it, let them consider the reverse case and suppose iron weights dropped through the water. It is evident enough here that the greater the size of the weight, the more will it tend to force the water down with it as it falls through the pipe; and the smaller the pipe, the more contracted the passage for the water upward past the falling weight. The same law which applies to the bodies heavier than water applies to these which are lighter.

Turning now to the history of the air-lift pump as an invention, the earliest patent on this method of lifting water of which we have been able to find mention is United States patent No. 333,499, dated Oct. 19, 1880, and issued to Mr. Joseph P. Frizell, M. Am. Soc. C. E., for a "Method of Raising Water." At our request Mr. Frizell has furnished us the following interesting particulars concerning the manner in which he came to make this invention:

I had long had in mind a method of compressing air which is the reverse of the air-lift pump. Whereas the latter, by means of air in a state of compression, causes a column of water to ascend, the former, by means of a descending column of water, puts air in a state of compression. This method was suggested by observing the very moderate velocity with which bubbles of air rise in still water, a velocity varying with the size of the bubble, from 9 ins. per second or thereabouts, for minute bubbles, such as result from a slight agitation of the water, to as many feet in the case of great masses of air. It occurred to me that bubbles of air generated in water which was moving downward with a moderate velocity, would be carried with the current, and subjected to a constantly increasing pressure. At the depth corresponding to the desired pressure, suppose the conduit, shaft or pipe to take a horizontal direction. In this part nothing opposes the rising of the bubbles. The air accumulates at the top, and may be conducted into a suitable chamber, to be drawn through a pipe as occasion requires.

Fig. 2 represents the practical arrangement for securing this result. A is a dam which causes a difference of level in the water above and below it. B is a descending shaft, with the curb C, built up around the entrance. The water enters the shaft over a weir, and is throuwn into a commotion, which impregnates it with air bubbles. These are carried to a sufficient depth to insure the required pressure. In the horizontal part D, of the passage, the air rises and enters the chamber F, and is drawn off through the pipe, H. The water freed from air rises and returns to the stream below the dam through the ascending shaft, G.

Experiments to test the efficiency of this method were made at the Falls of St. Anthony, in 1880. The results were published in the "Journal of the Franklin Institute," for September of that year, to which the reader is referred. The best efficiency was 52%, agreeing very closely with the efficiency recorded in Browne's tests of the air-lift pump. This result indicates, by fair deduction, an efficiency of 75% under practical working conditions.

Having worked out this system, it was an easy step to conceive of the injection of compressed air at the base of the descending column B, and so reversing the entire movement. Some rough experiments were made to test the principle of the method. An open pipe was fixed in a vertical position, from the deck of a floating scow, one end deep in the water, the other rising more or less above it. Air was injected into the lower end by the apparatus used for supplying divers. A patent was obtained in 1880.

The examiner to whom the application for this patent was referred reported in favor of rejection on the ground that filling the water in a pipe with air bubbles does not prevent the water from exerting its full pressure at the base: and that to expect water to stand higher inside an open pipe than outside was to expect a hydrostatic paradox, and was an absurdity. His doubts were removed by affidavits of parties who assisted in the experiments.

Mr. Frizell's air-compressing patent was dated Jan. 29, 1878. The claim allowed in Mr. Frizell's

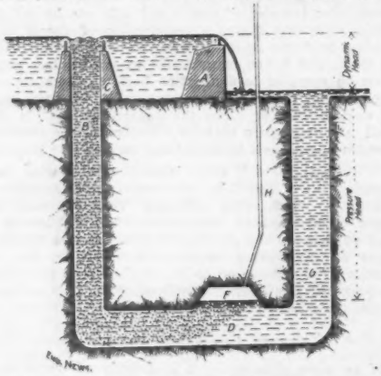


Fig. 2. Frizell's System of Air Compression by Direct Action of Falling Water.

patent of 1880 on a "Method of Raising Water," was as follows:

In the art of elevating water, the method of causing a column of water to ascend in a conductor by the weight of the external water, which consists in introducing a tube of the desired length at the required depth into the water to be elevated, and then injecting compressed air in the form of minute bubbles into the water at the lower end of said tube, thereby aerating the water, whereby a continuous stream is caused to flow upward to the point of discharge, substantially as described.

The same invention, practically, as that of Mr. Frizell was recently made quite independently by Prof. Elmo G. Harris, of the University of Missouri School of Mines. While sinking the piers for the foundation of a bridge over the Arkansas River, near Pine Bluff, Ark., Mr. Harris adopted the air lift pump for use in dredging. A 3-in. pipe 20 ft. long was set vertically with its upper end about 4 ft. above the surface of the water, and the lower end resting on the sand bottom in about 16 ft. depth. About 6 ins. above the lower end of the pipe a 1-in. pipe was tapped into the large pipe at right angles and air was forced into it by the ordinary air pump and hose used for supplying air to a diver's helmet. There was an abundant discharge from the top of the pipe, estimated by Mr. Harris as about equal parts of sand and water.

A patent was applied for, but was rejected by the Patent Office, on the same ground that Mr. Frizell's patent had been when first presented, but the final rejection was based on the Frizell patent above referred to and also the patents of Capt. Jas. B. Eads, 105,056, July 5, 1870, for a hydraulic jet sand pump; Smith & Cliff, 323,458; and Stone, 281,415, which were also for hydraulic excavators. Reference was also made to a paper by Werner Siemens, in "Verhandlungen des Vereins zur Bedford d. Gewerbfleisses," March, 1885, S. 80-82. We are indebted to Professor Harris for a copy of the papers in his case, from which the above information is obtained.

Searching for further information with reference to Dr. Siemens' invention we find in the Proc. Inst. C. E., vol. LXXXI, p. 400, an abstract taken from "Dingler's Polytechnische Journal," vol. CCLVI, p. 284. The substance of this is, that the air-lift pump was invented by Dr. Siemens while sinking a mining shaft in the neighborhood of Berlin. The shaft was put down by the Poetsch freezing process through about 100 ft. of quicksand, but the ice melted before the sides were made watertight and the shaft was drowned out. It was attempted to stop the flow of water into the shaft by putting down numerous driven wells around the shaft, but these were so small in size that it was difficult to pump from them. It occurred to Dr. Siemens, therefore, to imitate the action of gas springs, geysers and flowing oil wells by conveying compressed air to the bottom of the well casing. The concluding paragraph of the abstract hints at much earlier inventions based on the same principle as the air-lift pump as follows:

Gerlach, in "Zeitschrift des Vereines deutscher Ingenieure," 1885, p. 311, has pointed out that this system of lifting water was recommended by Loescher, of Freiberg, in a pamphlet published in 1797; but it does not appear to have been tried, except in laboratory experiments.

Still another hint concerning earlier inventions of this sort is found in a paper by Prof. W. H. Echols, of the University of Virginia, which was read before the Philosphical Society of that institution. Professor Echols described Professor Harris' pump, discussed its theory at length, and said:

The idea of such a lift is not a new one. In Collon's "Lectures on Mining," delivered at the School of Mines in Paris (see English translation, Paris, 1876, pp. 307-308), in his description of Triger's method of sinking a mining shaft through very aquiferous strata at Chalonnes, by means of a pneumatic cylinder, he gives the following design for expelling water and sand from the lowest compartment:

Then follows an outline description of the scheme, the substance of which is that the mixture of air and water in a vertical pipe forms "a kind of froth having a less density than water, thus allowing it to be raised to the surface, where it flows out."

The inventor who has done most to bring the air-lift pump into practical use, however, is Dr. Julius G. Pohle, an analytical chemist and mining engineer, who for many years had a laboratory at Broadway and Broome St., New York city, succeeding Dr. James R. Chilton. Some years ago Dr. Pohle became the manager of some Colorado mines, and in connection with the operation of another type of pneumatic pump discovered that an advantage was gained by the introduction of compressed air into the discharge pipe. A patent (No. 338,295) was issued March 23, 1886, to Messrs. Pohle and Hill for a form of the old alternate-acting compressed air pump, in which a chamber is filled alternately with compressed air and with the water or other fluid to be elevated, the air being allowed to escape as the chamber fills, and being forced in to cause the water to ascend the discharge pipe.

This type of water elevator is simply an automatic arrangement on the well known "Montejus" plan, in which the compressed air acts only by the direct pressure upon the surface of the water. In a second patent (No. 347,196), issued to the same parties Aug. 19, 1886, it is proposed to use, in combination with this old and well known device, fine streams of air entering the pipe at different points of its height, and ascending in bubbles through the rising column of liquid. The claims of this patent cover merely the combination of the air-lift principle with the "Montejus" or with pumps of the ordinary form. It is of interest to note that the invention in this case was stumbled upon by accident.

Naturally it was but a step from the operation of the air-lift pump in connection with the "Montejus" to its use as an independent means of raising water.

In 1888 exhibits of the performance of the air-lift pump were made at the Alameda, Cal., waterworks, and Prof. P. M. Randall, of San Francisco, at the request of Dr. Pohle, made a careful investigation of the theory and practical value of the pump. His report was so favorable that another experimental plant was put in operation in San Francisco and numerous tests were carried out by Professor Randall in company with Messrs. Ross E. Browne and H. C. Behr, M. Am. Soc. M. E. A

paper was read by Mr. Browne before the Technical Society of the Pacific Coast in February, 1890, describing the results of a test.

The pump tested was of the simplest description, consisting merely of a 3-in. discharge pipe and a 1-in. air pipe supplying compressed air to the bottom of the discharge pipe. Fig. 3 illustrates diagrammatically the pump as arranged for testing. The test showed an efficiency of from 25 to 50%; but the apparatus used was not well designed to secure the greatest efficiency, and the report of the test stated that these efficiences could have been increased by a few simple alterations. We reprint as follows the portions of their report which are of chief interest:

The diameter of the pump column was 3 ins., of the air pipe, 0.9 in., and of the air discharge nozzle ⅝ in. The air pipe had four sharp bends and a length of 35 ft. plus the depth of submersion.

The water was pumped from a closed pipe well (55 ft. deep and 10 ins. in diameter), and was discharged

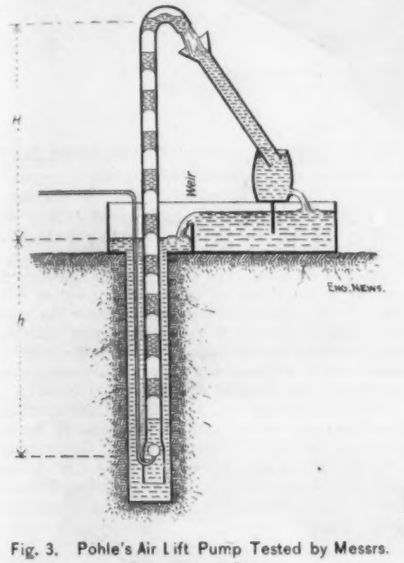


Fig. 3. Pohle's Air Lift Pump Tested by Messrs. Browne and Behr.

into a tank and delivered—over a quadrantal weir—back to the well. A long mercurial column was connected with the receiver for the purpose of obtaining accurate measurement of pressure. The quantity of air delivered to the pump was obtained by two methods, as follows:

1st Method.—The capacity of the receiver was measured and found to be 117 cu. ft. The escape cocks from the receiver were closed and the compressor was started. Beginning with atmospheric pressure, the increase of pressure was noted for each 30 strokes of the compressor-piston, until a pressure was reached beyond that required in the pump tests. The compressor made uniformly one stroke per second. The atmospheric pressure was 2.51 ft. of mercury. The air was unusually dry.

From these data was calculated the number of pounds of air delivered, per piston-stroke of the compressor, to the receiver at any required pressure. An average of the results of the two separate tests was adopted.

2d Method.—A small auxiliary chamber was attached to the receiver. Compressed air entering this chamber escaped into the atmosphere through a carefully measured circular orifice in a thin plate. After a pump test had been completed, the compressor was kept running, the cock in the pipe to the pump was closed, and the cock in the pipe from the receiver to the auxiliary chamber was opened and adjusted until the conditions in the pump test, regarding number of strokes of compressor per minute and the pressure in the receiver, were reported and maintained.

The pressures and temperatures of the compressed air in the chamber and of the atmosphere furnished the data upon which to base a calculation of the quantity of air escaping through the circular orifice. This quantity was evidently the same as that supplied in the pump test. Such tests were made from time to time, and served to check the values determined by the first method.

No test of the efficiency of the entire plant was made, but the efficiency of the pump shown in the accompanying table was based on the least work theoretically required to compress the air and deliver it to the receiver. If the efficiency of the compressor be taken at 70%, the efficiency of the pump and compressor together would be 70% of the efficiency found for the pump alone. The temperature of the air in the receiver during the tests was 73° to 78°, of the outside air 68° to 76°, and of the water 67° to 70°.

An inspection of the table shows (1), that for a given submersion (h) and lift (H) the ratio of the two being kept within reasonable limits, (H) being not much greater than (h), the efficiency was greatest when the pressure in the receiver did not greatly exceed the head due to the submersion; (2), that the smaller the ratio H ÷ h, the higher was the efficiency.

We may say in a general way that under the better adapted pressures in the receiver, the pump, as erected, showed the following efficiencies:

For $\frac{H}{h} = 0.5$	50%
" " 1.0	40
" " 1.5	30
" " 2.0	25

It is apparent that the air pipe should not have been reduced at the discharge end, as such reduction necessitated a greater pressure in the receiver for the delivery of the air to the pump. Unfortunately, the data is wanting for a reliable estimate of the loss due to the frictional resistance in the small air pipe. A rough estimate shows that such loss must have been large. The substitution of a 1½ in. air pipe in place of the 1 in. would have appreciably augmented the efficiencies given in the table. In justice to the pump, a considerable allowance should be made for this easily avoidable loss. The last test in the table shows a limit of lift for a given submersion, beyond which a large excess of pressure is required to pump even an insignificant quantity of water.

We may add to this that apparently one cause of the marked increase in efficiency as the pressure of air is reduced to approach that corresponding to the head of water is the very considerable decrease in the rate of flow and consequently in the loss by friction.

Results of Tests of an Air Lift Pump by Messrs. Ross E. Browne and H. C. Behr.

Water lift (H), ft.	Submersion (h), ft.	Pressure corresponding to (h), lbs. per sq. in.	Pressure in receiver above atmospheric, lbs. per sq. in.	Weight of air supplied, lbs. per sec.	Water pumped, cu. ft. per sec.	Work of isothermic compression (L), ft. lbs. per sec.	Work of water lift (W), ft. lbs. per sec.	Ratio $\frac{H}{h}$	Per cent. efficiency of pump $\frac{W}{L}$
15.3	36.3	15.7	23.1	.082	.3540	2,105	338	0.4	16
15.3	36.3	15.7	17.4	.043	.3182	918	304	"	33
15.3	33.3	15,7	16.2	.028	.2558	572	244	"	43
35.1	53.2	23.1	30.6	.078	.3136	2,459	687	0.6	28
35.2	53.1	23.0	26.8	.061	.3014	1,770	662	"	37
35.0	53.3	23 1	24.9	.041	.2425	1,150	530	"	46
35 0	53.3	23.1	24.0	.030	.1941	802	424	"	53
20 3	31.3	13.6	21.9	.082	.2954	2,050	374	0.7	18
20.3	31.3	13 6	15.1	.040	.2398	769	304	"	39
20.3	31.3	13.6	14.4	.031	.2086	594	264	"	44
26.3	25·3	11.0	20.3	.083	.2296	2,013	377	1 0	19
26.3	25.3	11.0	15.8	.059	.2050	1,178	336	"	29
26.3	25.3	11.0	12.5	.033	.1420	558	235	"	42
75.2	51.0	21.0	31.1	.078	.1755	2,408	824	1.4	34
75.4	52 8	22.9	30.8	.078	.1799	2,454	846	"	34
75.3	52.9	22.9	27.6	.059	.1488	1,716	700	"	41
75.3	52.9	22.9	25.4	.041	.0757	1,156	356	"	31
54.7	33.6	14.6	23.8	.081	.1528	2,151	575	1.6	24
54 7	33.6	14.6	17.4	.049	.0824	1,056	281	"	27
54.5	33.8	14.6	16.1	.033	.0576	681	196	"	29
31.5	20.1	8 7	18.9	.084	.1488	1,922	291	1.6	15
31.5	20.1	8.7	12.3	.052	.1126	960	221	"	23
31.3	20.3	8.8	10.0	.031	.0633	432	124	"	29
34.0	15.6	6.8	17.1	.096	.0093	1,818	153	2.3	9
36 0	15.6	6.8	10.1	.052	.0034	749	95	"	13
36.0	15.6	6 8	7.4	.029	.0093	323	21	"	7
62.1	26.2	11.4	20.6	.083	.0931	2,041	361	2.4	18
62.4	25.9	11.2	15.2	.056	.0663	1,490	218	"	24
62.4	25.9	11.2	12.3	.029	.0185	489	72	"	15
69.9	18.4	10.0	18 8	.084	.0338	1,904	147	3.8	8
69.6	18.7	10.0	11.9	.050	.0067	837	29	"	3
41.0	10.6	4.6	15.8	.087	.0146	1,757	37	3.9	2
41.0	10.6	4.6	7.1	.035	.....	382	...	"	..

Subsequent experiments proved that the pipes used in the test were not correctly proportioned to each other, and were very rough inside, thus materially reducing the efficiency of the apparatus.

In a later paper read before the Technical Society (but owing to its length not printed in its Transactions), Professor Randall investigated the theoretical efficiency of the air lift pump and showed that with properly designed and constructed apparatus the efficiency would be far above that found in the tests of Messrs. Browne and Behr. Thus in the test which showed only 52.4% efficiency in a 3-in. pipe, a properly designed apparatus should show 80.4% efficiency. He also gave examples of the efficiency of pumps of large size, stating that with a 12-in. air pipe and 24-in. water pipe, the latter submerged 55.5 ft. and elevating the water 55.5 ft. above the level in the sump, an efficiency of 87.46% was possible, which could be increased to 90.37% by enlarging the air pipe to 18 ins. diameter.

Recently (Dec. 6, 1892) a patent has been issued to Dr. Pohle (No. 487,639) covering an air-lift pump in which the air is introduced in sufficient volume to form bubbles completely filling the pipe and thus creating a series of alternate layers of air and water in the pipe. The "slip" which occurs where small bubbles rise through the water is thus avoided.

Dr. Pohle is certainly entitled to much credit for the time and money he has spent in developing and exploiting the pump. Some months ago arrangements were made by him with Mr. Alex. E. Schnee, of 48 Exchange Place, New York City, to place the pump on the market, and since that time a large number of the pumps have been put in service. John F. Haskins & Co., 1107 Monadnock Building, Chicago, are the Western agents for the pump.

Turning now to the practical advantages of the pump, it is evident that it deserves the careful consideration of hydraulic engineers. The fact that there are absolutely no moving parts makes the pump especially fitted for handling dirty or gritty water, sewage, mine water, and acid or alkali solutions in chemical or metallurgical works. For a deep well pump, especially for non-flowing artesian wells, it has very much to recommend it. Another important use for these pumps is for water supply service, where the thorough aeration which can be secured by use of the system is a strong point in its favor.

In Newark, N. J., a single company has pumps of this type at work having a total capacity of 1,000,000 gallons daily, lifting water from three 8-in. artesian wells. The Newark Chemical Works use an air-lift pump to raise sulphuric acid of 1.72° gravity. The Colorado Central Consolidated Mining Co., in one of its mines at Georgetown, Colo., lifts water in one case 250 ft., using a series of lifts.

As the advantages of this pump become generally known, it seems destined to a very wide field of usefulness. The repair bill of ordinary pumps working on gritty or acid water is enormous; and even centrifugal pumps, steam vacuum pumps and steam jet pumps require frequent repairs when handling such fluids. This pump alone seems to possess the ideal cheapness and durability for this work.

The theory of the pump offers an inviting field for theoretical investigation and experiment. For example, Prof. E. G. Harris, in his communication before referred to, proposes the following problem:

An air bubble of given volume is released at a given depth under water, in a vertical pipe of given diameter, open at both ends. Investigate the form of the bubble and its velocity of ascent: 1. Where the pipe extends indefinitely above water. 2. Where the top of pipe is flush with surface of water.

Other questions well worth investigation, from a practical point of view, will doubtless suggest themselves to our readers. We will only propose, as a sample, the query: When might this pump be made to work with an efficiency of over 100%? and answer by saying that Professor Randall's investigation showed that with air at 25 lbs. pressure and 60° F., the efficiency in raising water of its own temperature would be 79%, and would gradually increase with increase in the temperature of the water, until when the water was at 200° the efficiency would equal 100%.

We are indebted to Mr. Frizell for the following discussion of the theory of losses in the air lift pump, and also in the air compressing system:

These two inventions—compressing air by the action of a descending column of water, and causing a column of water to ascend by action of compressed air injected therein—are complements of each other. In the first, air is compressed strictly on the isothermal line, and it is free from the thermal difficulties incident to machine compressors. In the second, compressed air is expanded on the isothermal line, and a considerable percentage of the energy expended in lifting the water is furnished by the water itself in the form of heat. In the former the air is reduced to a tension corresponding to the depth of the point of delivery. In the latter the air cannot be economically

used at a tension greater than that corresponding to the depth of the point of introduction.

In the air-compressing system the losses of energy consist of:

1. The head expended in producing the commotion at the entrance to the descending shaft.

2. The head necessary to impart the velocity.

3. What may be called the "slip" of the air-bubbles—that is, the amount by which their velocity falls short of that of the water. If, for instance, the bubbles are of a size to rise 9 ins. per second in still water, then in water moving with a velocity of 60 ins. per second, 9-60, or about 15%, of the energy will be lost.

4. The friction of the water in the several passages.

In lifting water by compressed air, Loss 1 has its counterpart in the loss incident to the introduction of the air. Loss 2 is the same, and so is Loss 3, the excess of velocity of the air bubbles over that of the water. This appears to show that the small bubbles are more favorable to high efficiency than large ones, as they rise more slowly. In a small pipe, the aggregation of air into masses that would fill the pipe might have a favorable effect; but in a pipe large enough to permit of free movement, the minutest subdivision of the air would be most favorable to efficiency. The fourth loss is the same as in the first system.

In the lifting system, the quantity of air admitted must be learned from experiment. The compressing system has a certain self-regulating property in this respect. Suppose the descending shaft to draw from a millpond into which a certain quantity of water flows. The same quantity will go through the compressing system, if there is no other place of egress. The quantity drawn determines the velocity through the descending shaft. The water in this shaft will load itself with just the quantity of air that it can carry at this velocity—no more and no less. If it takes too much, the velocity will be checked, the water will rise in the shaft, at the entrance; the commotion will diminish, and less air will be taken in. If it takes too little, the velocity increases, the level falls in the shaft; the water enters with greater commotion and more air is taken up.

There is reason to think that air bubbles resulting from commotion of water, are of uniform size, and in moving vertically have no tendency to aggregate in masses. On the contrary, they exhibit a remarkable tendency to dispersion and uniform distribution, a tendency suggestive of electric action, causing mutual repulsion. Bubbles of air under uniform pressure entering water through uniform minute orifices would be uniform in size, and would have no tendency to aggregate in masses. If not uniform, the larger would overtake the smaller in ascending, and vice versa going down. If the pipe takes a horizontal or inclined direction, aggregation follows at once.

In the compressing method, it is essential that the pressure head should be large in comparison with the dynamic head (see Fig. 2). In the lifting method it is essential that the submersion should be large in comparison with the lift. If in the first we indefinitely diminish the pressure head and increase the dynamic head, we reach a point where the system merges into the old "Trumpet" or bellows of the Catalan forge—a column of water falling freely down a shaft and dragging air with it. If, in the second, we indefinitely diminish the submersion and increase the lift, we come finally to a column of spray blown up a spout by a jet of air—an action analogous to that of the injector.

SOME AUTOMATIC BRAKE-SLACK ADJUSTERS.

It is now pretty well understood by railway men that to get effective action from airbrakes it is necessary to take up the slack at frequent intervals as the brakeshoes wear. Otherwise the leverage of about 1 to 10 between the cylinder and the brakeshoe, with the spring of the rods and brakebeams, will cause the piston to travel so far that it will strike the bottom of the cylinder when the brakeshoes become worn. It is at present the duty of car inspectors to keep the brake slack correctly adjusted by hand, a duty which on freight cars, at least at busy interchange points, is said to be more honored in the breach than the observance. Some ingenious indicators have been devised for facilitating this work by showing to the car inspector at a glance how far the brakes have traveled. We illustrated two of these devices in our issue of Dec. 20, 1890.

It is generally conceded, however, that the future lies with the device or devices which will adjust the slack automatically and will keep the brake always in adjustment to do its best work.

We illustrated an automatic slack adjuster invented by Mr. R. A. Parke, the New York representative of the Westinghouse Air Brake Co., on Sept. 15, 1892, and we show herewith three other automatic slack adjusters which are now on the market.

The Hinckley adjuster, which has been longest before the public, is shown in Fig. 1. The rod there shown is the cylinder lever rod. It is made in two parts, with right and left-hand screw threads engaging with threads cut on the interior of a sleeve. This sleeve has two ratchets keyed on it, for rotating the sleeve in either direction to shorten or lengthen the rod. These ratchets are worked by pawls connected to a projecting lever. When the stroke of the piston and consequently the movement of the rod exceeds a fixed amount, this lever strikes the under side of a bracket attached to the car body and is deflected downward, turning the ratchet one tooth and shortening the rod. To let out the slack, when new shoes are to be put in, the lever is worked a few times in the opposite direction, turning the other pawl and increasing the length of the rod.

One adjuster of course takes up the slack for both trucks. The upper ends of the dead levers do not require the usual arrangement for hand adjustment and the dead lever guides may be dispensed with.

Tests of this adjuster on the Philadelphia & Reading during the months of November and December, 1892, showed that in 56 days out of 60 the piston travel on a car with this adjuster was not less than 5 or more than 6 ins. The four days when a greater travel occurred were days when the car inspector applied new shoes and left some slack in the rigging, which was recorded on the next stroke of the piston (the device requiring one stroke to take up the slack).

Similar tests were made with the slack adjusted by hand at intervals of two days to a week, on a car in the same service (177.6 miles per day in a suburban train, making over 400 stops daily). The piston travel was observed every day with the following results:

Piston travel.	Under 7 ins.	7 to 9 ins.	9 to 11 ins.	Over 11 ins.
No. of days.	1	34	20	6

The "Q. & C." adjuster, which has been developed and placed on the market by the well known Q. & C. Co., is shown in Fig. 2; and Fig. 3 shows its application to the brake rigging of a car.

The adjuster is designed to lengthen or shorten the same lever as that to which the Hinckley adjuster is applied, but it is attached to one end and forms the connection to the cylinder lever. The end of the cylinder lever rod is threaded and engages with an internally threaded sleeve which is turned by a gear to take up the slack.

This gear derives its motion from the cylinder lever, which carries a pawl engaging with the gear, as shown in Fig. 2.

As seen by the drawing, this arrangement is exceedingly compact and easy of application. There are no additional parts and no changes to

FIG. 1. THE HINCKLEY AUTOMATIC BRAKE SLACK ADJUSTER.

be made in the brake rigging beyond drilling one hole in the cylinder lever and welding a threaded end in place of the eye on the cylinder lever rod.

We are informed that this adjuster has been in use on at least five railways running out of Chicago during the past winter and under the most severe conditions of weather, with very satisfactory results. It will be noticed that the working parts of the adjuster are inclosed in a case, thus preventing any clogging of the working parts.

Fig. 4 shows the "O. K." slack adjuster, which has been put on the market by Pratt & Letchworth, of Buffalo, N. Y. As seen by the drawing, the rod to which the adjuster is applied is the push rod from the end of the cylinder. The adjustment is made by pawls engaging with racks on the surface of the rod. We understand that it is already in successful use on several different railways.

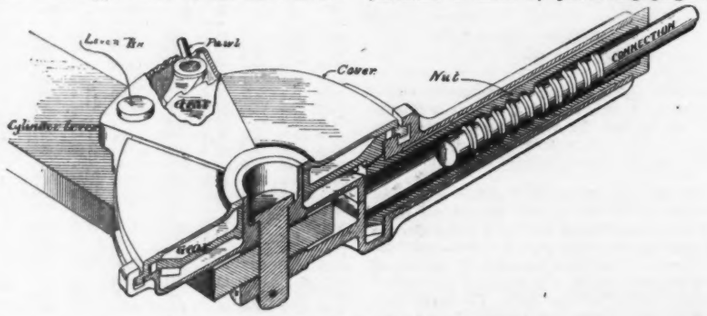


FIG. 2. THE Q. AND C. SLACK ADJUSTER.

REGULATING THE RATE OF FILTRATION THROUGH SAND.*

By Prof. William Kinnimond Burton, Assoc. M. Ins. C. E.

The different and sometimes apparently contradictory results that various experimenters in sand filtration have arrived at, whether the tests for purity before and after filtration are biological or chemical, seem to indicate that all the factors of successful filtration are not thoroughly understood. Mr. B. Nojiri, Chief Engineer to the Osaka (Japan) Water-Works, was occupied with elaborate experiments on the effects of varying the speed of filtration at the time of his death early in 1892. The results of these experiments will probably be published at some future time. Meanwhile it may be of interest to know that the results of biological tests were different from those of chemical tests. Thus, as the velocity of filtration was reduced, the purity of the water, as chemically tested, increased until a velocity of 20 lin. ft. in 24 hours was attained; but as the velocity was further reduced, the

*From Excerpt Minutes of Proceedings of the Institute of Civil Engineers, vol. cxii, Session 1892-3, Part II.

filtration, as indicated by chemical tests, became less efficient. In the case of biological tests, on the other hand, the number of bacteria decreased till the speed of filtration was reduced to 10 ft. in 24 hours, beyond which point there appeared to be no advantage in reducing the velocity.

Whatever filtering velocity may be the best, it would appear to be essential to efficient filtration that the velocity should be kept uniform, and it would seem that engineers have scarcely given to this matter the attention that it deserves. Any arrangement for accurately regulating the velocity of filtration is frequenly absent from published designs of water-works. The necessity for such an arrangement was pointed out by Mr. James P. Kirkwood 25 years ago, and he adopted a movable sluice with the water flowing over the top for regulating the speed of filtration. He pointed out that, where there were several filter beds, it was desirable to have a regulating arrangement for each one. Mr. Henry Gill, M. Inst. C. E., has several times described an ingenious arrangement adopted for this purpose at the Berlin water-works. One of the simplest methods of regulating the speed of filtration is by the use of a telescopic tube on the discharge pipe from the filter. This pipe is so arranged that its upper end can be raised to the level of the water in the filter bed. In this case no water will flow through the sand. By lowering the level of the pipe a "filtering head" is produced, and this "head" may be altered as appears necessary from time to time from the sand becoming gradually clogged. For the Nagasaki (Japan) water-works the author designed an arrangement consisting of three telescopic pipes, one on the outlet of each of three filter beds, all arranged in one well. A filter can be filled with filtered water from below by lowering the telescopic tube as far as possible, and partly closing the valve on the outlet of the well. The water from the other filter beds then backs up in the discharge drain. The reason for filling the filter beds from below, at any rate until the water covers the sand by 2 or 3 ins., is that, before the water has reached that level, the rate of filtration is quite out of control, with the water admitted in the ordinary way—only a small portion of the sand bed near the admission pipe actually being in use.

The author, being engaged in the early part of 1888 in designing a water-works for Tokio, in connection with which filtering will have to be conducted on an extensive scale, paid considerable attention to means of regulating with precision the flow of water through the filters. He premised as essentials for a perfect system of regulating the discharge from filter beds:

(1) It shall be possible to adjust the filtering to any determined speed, and, once adjusted, the speed shall remain constant, even if the head necessary to overcome the friction of water passing through the sand varies; (2) it shall be possible to fill the filter beds from below with filtered water; (3) the waste of water in cleaning out filter beds shall be reduced to a minimum; (4) the apparatus shall indicate when a certain maximum head for overcoming the friction of the filter bed has been reached. The valve arrangement shown in Fig. 1 was designed to effect these purposes. The water enters the valve from the filter bed at A, and is discharged into the filtering well, which is in connection with the clear water reservoir, at B. The balanced valve, C, is controlled by a piston, D, the upper side of which is open to the water in the well. The arrangement is similar to that of a reducing valve. The object is to keep the difference of pressures in the valve body and the clear water reservoir constant. If this is done, the discharge through the whole apparatus, which passes through a circular orifice in a movable diaphragm, E, will be constant. If the discharge tends to exceed that decided on, the pressure inside the valve body, against the under side of the piston, D, increases, the piston rises, and the balanced valve is partially closed. If, on the other hand, the discharge tends to decrease, the pressure on the inside of the diaphragm and on the under side of the piston decreases, the piston and valves fall by gravity and the flow is increased. A small hole is made through the piston to prevent the accumulation of air below it, which would disturb the working. The slight leakage through this hole does not materially influence the working of the valve. The quantity of water to be passed may be determined either by the size of the diaphragm or by the weight of the piston and valve. The piston and valves with spindle are weighed in water. This weight, divided by the area of the piston, gives the differential pressure at the diaphragm, and it is a simple calculation to find what diameter of aperture is necessary to pass a given quantity of water with this pressure. When the valve drops on the bottom of the casing, it is an indication that the head due to the difference of level between the water in the filter bed and that in the well is needed to overcome the friction of the water passing through the sand, and that the filter needs cleaning. It is customary to clean filter beds at fixed intervals of time, but it would probably be more economical to let each bed work until a certain head of water was necessary to overcome the friction of the sand. An indicator could easily be fitted to the valve so that the dropping of the piston should be made apparent above the surface of the water in the well. A screw-spindle for actuating the valve by hand is shown in the drawing (Fig. 1).

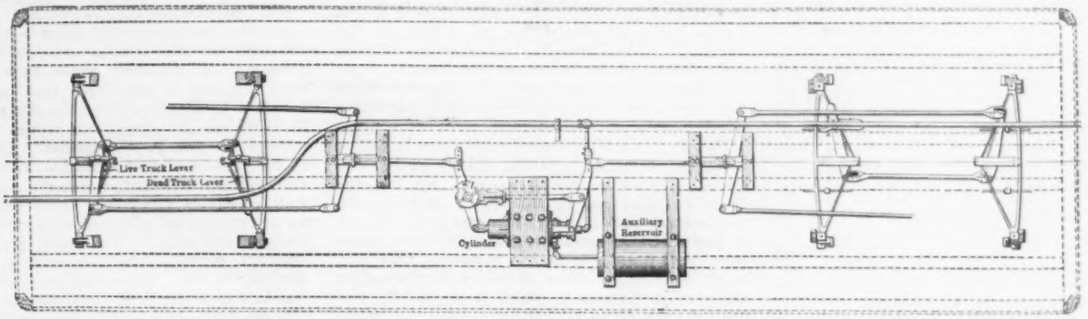


FIG. 3. APPLICATION OF Q. & C. ADJUSTER TO CAR

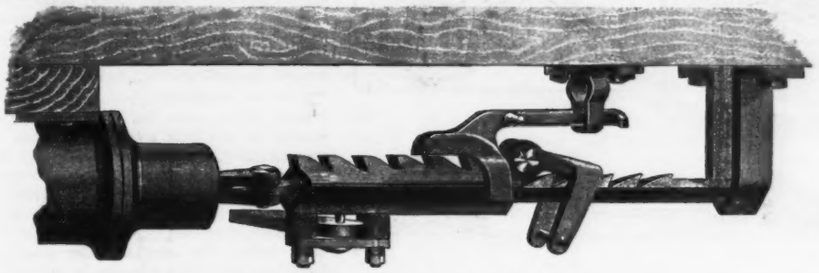
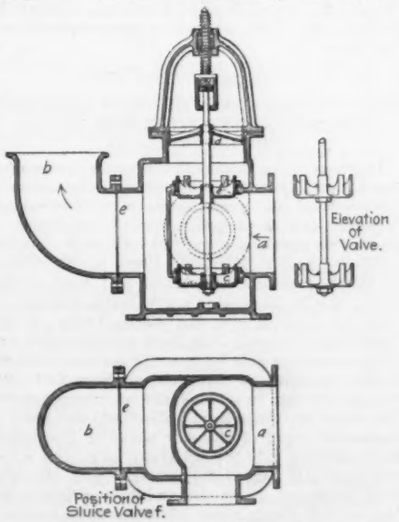


FIG. 4. THE "O. K." SLACK ADJUSTER.



Regulating Valve for Filter Bed.

The action of the whole arrangement is as follows: The level of the water in the filter bed is kept uniform by an automatic valve that it is not necessary to illustrate, as its principle is well known. The velocity of the flow is, as already described, kept constant by the automatic action of the valve, until the filter bed has become clogged to a certain extent. The valve then drops to the bottom of the body. If, now, the flow of water into the filter bed be stopped, what is above the sand will slowly drain away, none being lost. When it has so drained away, or when it is desired to stop the operation, the valve is closed by screwing it up by hand. The sluice valve F is then opened, and the water, as far as is considered necessary, is allowed to run to waste. In filling, the valve is depressed by hand, and the filtered water in the well backs up the drain of the filter bed. When the sand has been covered by 2 or 3 ins. of water, the rest of the depth may be filled in the usual way. It will be evident that if it is wished to run the first of the water, after refilling a filter, to waste, this can readily be done; also that the filter can, if it is wished, be made to work at a reduced rate for a short time after filling, either by adjusting the spindle so that the valve can fall only a certain distance, or by removing weights placed on the piston and adjusted to normal working.

A valve of the kind described was made at the Engineering College of the Imperial University, Tokio, and tried in connection with the small University water-works. It was found that if the pressure at the inlet of the valve was suddenly changed, there was, for an instant, a change in the differential pressure at the diaphragm due to the inertia of the valve; but that, however great the change, if made slowly, the differential pressure, and consequently the discharge, remained constant. This arrangement is being adopted for the Tokio water-works and for the Osaka water-works, and the author trusts it may prove useful in other cases.

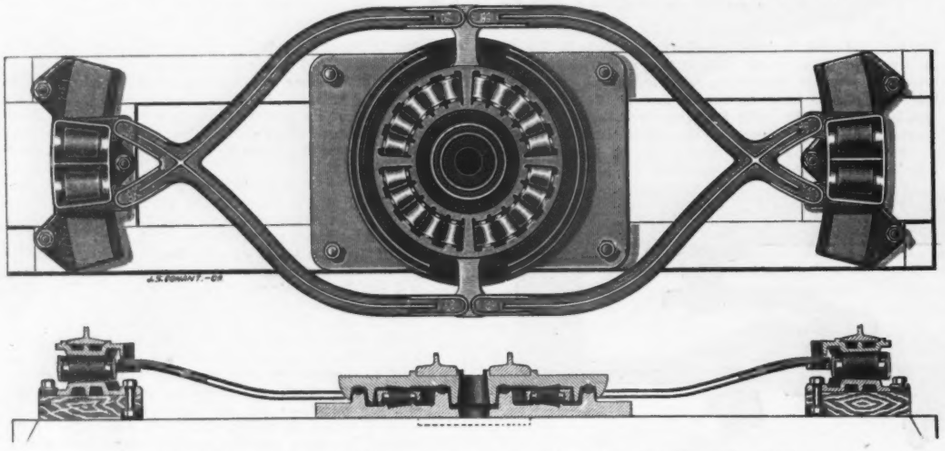
THE ACCIDENT AT THE AUSTIN DAM.

So much has been published concerning the great dam across the Colorado River, at Austin, Tex., that engineers will be especially interested in the reports concerning the washout which has occurred at its east end. We give herewith the fullest newspaper reports which have appeared concerning the accident, and hope to present next week an exact statement from reliable sources of the present state of affairs:

Austin, Tex., May 30.—The breakage at the dam proves upon inspection to be more serious than at first apprehended. The special friends of the enterprise admitted early this morning that water was seen issuing from under the penstock at the headgate masonry which is attached to the east end of the dam, but does not go near as deep as the dam foundations, which, consequently, are not likely to be undermined to any extent. Still, the expense of shutting off the water by coffer work, so the breach can be repaired, will probably be some $30,000 or more. It is expected that the crevice will be closed as soon as the water can be run

down in the lake some 10 or 12 ft., which will not lower the lake enough to interrupt the regatta. At all events, it can be permanently remedied by extending the headgate masonry deeper and farther into the east bank. Experts claim that the dam proper will not be injured. The Austin people were greatly excited at first on account of exaggerated reports, but now feel relieved of serious apprehensions. At 10 o'clock to-night there was no change, except a slight fall of the river and lake. It may be several days before the water is reduced so as to ascertain the situation fully.—St. Louis "Globe-Democrat."

Austin, Tex., May 31.—The damage at the great dam across the Colorado was greatly increased this morning at 1 o'clock when another great seam suddenly appeared in the bank opposite to the masonry, and much of it caved in and sent a great pile of granite blocks over and down upon the penstocks. At the same time the massive masonry inclosing the penstocks gradually went down at the east end, making a great crack in the wall where it leaves the top of the dam. The granite wall inclosing the wheel pits was swept away. Several of the pits were utterly destroyed, and the machinery in them tossed about and carried off by the force of the roaring torrent sweeping through the cavern under the penstock level. To-day water is working its way through nearly all the masonry surrounding the penstocks, and it will be a total loss. Some of the large penstocks and machinery have been injured, and a conservative estimate places the loss to the city at $200,000. It appears now that the plans of Engineer Frizell, who had charge of the work from its inception, but who was relieved before its completion, were not carried out, and the masonry failed to be extended into the east bank some 50 ft. to a point designated by him. To this error is the accident attributed. It is believed that the accident will not interfere with the regatta, which is to come off next week. Even if the water is lowered 20 ft. there will still remain a magnificent course for the oarsmen.—New Orleans "Times-Democrat."



THE JEWETT ANTI-FRICTION ROLLER BEARING FOR PASSENGER CARS.

THE JEWETT ANTI-FRICTION ROLLER BEARING.

The need of some form of roller bearing for car bodies which will do away with the excessive friction due to the present form of bearing plates, and at the same time one whose rolls will neither wear flat nor become wedged fast, is generally recognized by railway men. We illustrate in the accompanying cut a roller bearing for passenger cars invented by Mr. Luther K. Jewett, of Boston, Mass., which possesses several excellent features and has given very satisfactory service on a number of railways. As will be seen from the illustration, the device consists of a center bearing and two side bearings, each consisting of a series of conical steel rolls which are interposed between the bearing surfaces attached to the car body bolster and the bearing surfaces attached to the truck bolsters. These rolls are separated from each other by a spacing frame or cage, which serves to keep the rolls out of contact with each other and in their correct working position. The spacing frames or cages are connected by arms so that they move simultaneously. Moreover, the conical side rolls are much larger than the conical center rolls, so that the elements of both the side and center cones have a common center which is the center of the truck. The advantages of this construction are obvious. It will be seen that the rolls are provided with arbors upon which the spacing frame rests without coming in contact with the bearing surfaces, which rest directly upon the rolls.

As stated above, the bearing illustrated is for passenger cars. The bearing for freight cars, a patent for which is now pending, will be much simpler. Briefly stated, it will consist simply of the side bearings illustrated, the center bearing and arms being omitted, with an automatic device for bringing the rolls to the center of their line of travel when released from the weight of the car body. This device for centering the rolls obviates the possibility of the car body catching them at the end of their travel and grinding their faces flat. The importance of this freedom of movement will be readily understood.

The bearing for passenger cars is now in use on a number of railways, among which may be mentioned 72 cars of the Intramural Ry. at the World's Columbian Exposition, a train on the Baltimore & Ohio R. R., and on cars of the Boston & Albany, Old Colony, Fitchburg, Concord & Montreal and Boston & Maine railways. The cost of the bearing varies, of course, with the weight and size of the cars to which it is applied. For the ordinary four-wheel truck railway passenger car it is $35; for sleeping and drawing-room cars with six-wheel trucks it is $50, and for cars similar to those of the Manhattan Elevated Ry. it is $25. The freight car bearing will cost about $7 per car. The bearing is manufactured by the Jewett Supply Co., of Boston, Mass. President, James S. Churchill, Vice-President, Luther K. Jewett. Mr. F. W. Parsons is the company's selling agent.

THE ADJUSTMENT OF OLD PROPERTY MEASUREMENTS WITH THE STATUTORY STANDARD.

Every surveyor in the older towns and cities has had his own share of trouble in adjusting the measurements of his predecessors with the modern standard and the requirements of subdivision of lands. To these men the two exhaustive articles published by Mr. Edwin P. Clark in the "School of Mines Quarterly," for March and April, of this year, must be interesting and valuable reading.

In the last article Mr. Clark treats of the "standards" of early New York and Brooklyn, and tells much that will be news to surveyors not directly practicing in these cities. New York now has practically two standards of measurements. The first, or "down-town" standard, was used in laying out most of the city south of Fourteenth St., excepting only the old Dutch town and a few old farms; it agrees very closely with the City Hall tablet set up by the architect of that building, John McComb, about 1802; this 10-ft. standard measures 10.01 ft. by U. S. Standard. The Dutch town and the old farms referred to were laid out by a measure which was 1¼ ins. longer in 100 ft. than the U. S. standard.

The second, or "up-town" standard, was used by Randall in laying out Manhattan Island, above Houston St., according to the Commissioners' Map of 1807. It has generally been considered as equivalent to the U. S. Standard, though it is a trifle longer in long measurements, the excess averaging ¼ in., or .017 ft., in 100 ft. The Commissioners' Map of Morrisania was laid out by Findley, who in order to give "good measure," threw into each block enough to make his standard about .4 in. longer in 100 ft. than the U. S. measurement.

The first part of the present city of Brooklyn was laid out in 1788 by C. Th. Goerck, into blocks of several different widths and lengths. A comparison of several distances would indicate that the standard used bore the relation of 36 to 36.134 of the present U. S. standard. Other parts of Brooklyn were laid out by the "New York" standard, determined by Hassler, as having the ratio of 36 to 36.01545 of the Troughton scale, subsequently adopted as the U. S. standard. Other sections of the present city of Brooklyn were laid out by still slightly different standards, and surveyors were endeavoring to adjust them until 1869, when an act was passed under which a system of streets and avenues were devised, maps prepared and the territory surveyed and monumented by Samuel McElroy & Son. These surveys were made by a standard from the U. S. Coast Survey.

In the entire absence of uniformity in the older surveys it is evident that endless litigation would result from any attempt to make them strictly conform to the statutory standard. Consequently the best surveyor in Brooklyn, and in New York as well, considers each block as a standard in itself. They take its length at the regular statutory distance, as defined on the official maps, no matter what it may actually measure, and make their surveys accordingly and distribute the surplus usually found pro rata as far as possible, according to the lines of actual possession as indicated by buildings of several years' standing.

It is clear, says Mr. Clark, that this method is the only equitable solution of the difficulty, though the legality of the custom may sometimes be in question. The statute prescribes the U. S. standard as the only one permissible in the decision of controverted questions of measurement before the courts. The practical consideration of the question in individual cases will necessitate to a greater or less extent the examination of the title to the land on the block in question. If the original owner of the block caused a map of his property to be made and filed in the public record office, showing the block to be laid out into lots, of which the aggregate width equaled the official length of the block and sold his lots according to this map, he would be estopped from setting up any claim to any surplus that might be found to actually exist in that block in its total length. The same might probably be said of any owner who sold according to any actual map or plan, although not filed, which recognized the official length in contradistinction to the actual length. And all subsequent grantors using the description by lot numbers would be equally estopped, for it was the undoubted intention in referring to the map to designate a parcel of land of proportional size to the whole block, which the map indicated, irrespective of actual dimensions.

A more serious case is where a grantor has purchased his land by a description referring to the map and conveys by a new description, omitting any mention of the map. The question whether in this case we must adhere to the official legal or to the local standard of this particular block has been decided upon by the courts, in the case of Meyer vs. Bond (51 Hun., 291). The conclusion was that when there has been actual possession for the statutory period of limitation, or acquiescence by owners in the distribution of a surplus, it is binding on all, although the distances given in the conveyances do not accurately define the locus of the premises according to the statutory standard.

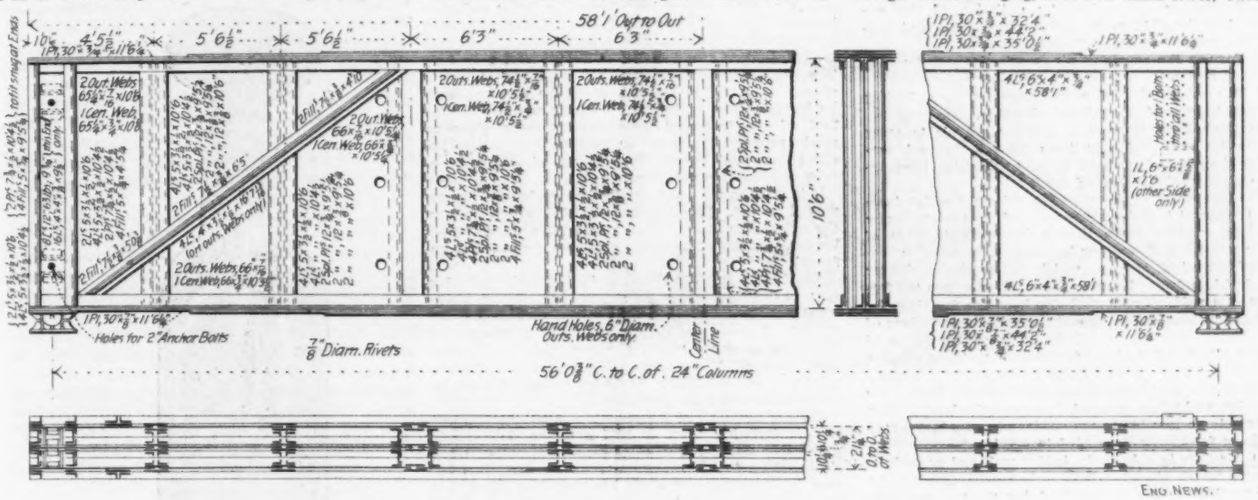
When property is conveyed where no map was originally used, a grantor, owning a whole block and conveying from each end by ordinary descriptions by distances, would undoubtedly retain title to the surplus land left when his conveyances did not meet. But adverse possesion might run against him, and the walls of the houses built would es-

tablish monuments which would govern (Muhlker vs. Rupport, 124 N. Y., 627).

Mr. Clark thinks that the acts of the various commissions, appointed to lay out streets in cities, might under some views be considered conclusive and their designation of a certain block as of a certain length as final. This is practically the law for the first city of Brooklyn outside the first five wards. Owing, however, to the paucity of adjudicated cases in the higher courts, the general question remains unsettled and each individual case must be considered in the light of the particular circumstances entering into it.

A 55-TON BOX GIRDER.

We illustrate in the accompanying cut the general design and construction of the large box girder being erected to support the Market St. wall of the Pennsylvania R. R. Co.'s new Broad St. station (Eng. News, Oct. 6, 13, 1892; June 1, 1893), at its crossing over Fifteenth St. The girder weighs 110,780 lbs., or 55.39 tons, and will carry about 1,000 tons of superstructure and assumed live load. It is 58 ft. 1 in. long out to out and 10 ft. 6 ins. deep back to back of angles, with



55-TON BOX GIRDER, BROAD ST. STATION OF PENNSYLVANIA R. R., PHILADELPHIA.

three webs connected by angle stiffeners and the cover plates, as clearly shown in the illustration. The two outer webs are 7-16 in. thick and the inner web is ¾ in. thick. The details of construction are so clearly shown in the drawing as to need no description. The girder was manufactured by Cofrode & Saylor, of Philadelphia, Pa., and was shipped from their works, at Pottstown, Pa., on two flat cars of 100,000 lbs. capacity each. When in place over Fifteenth St. it will have a span of 56 ft. c. to c. of columns, and will be 37 ft. above the sidewalk.

SMOKE PREVENTION.*

By Olin A. Landreth, C. E., Professor of Engineering Vanderbilt University.

When fresh coal is thrown on a bed of incandescent coal, or is otherwise highly heated, there immediately begins the distillation of the more volatile portions of the hydrocarbons in the coal, which distilled matter is burned if the temperature is high enough and a sufficient supply of oxygen is present, but which pass up the chimney as yellowish fumes if either of these two essential conditions of combustion are wanting. As the fresh coal becomes more highly heated the less volatile hydrocarbons are distilled, and these, being, chemically speaking, unstable compounds, are decomposed or disassociated by the heat at a temperature much below that at which the carbon thus liberated combines with oxygen in combustion. The temperature necessary for combustion of this free carbon is very high, approximately 2,000° F., and hence there is a wide margin of opportunity for this portion of the carbon to escape unburned, as this temperature is somewhat difficult to maintain in the mass of gaseous matter above the coal.

It is this free, unburned carbon, in a finely divided, incandescent state, which produces the bright, luminous flame, and which, when cooled, produces the black clouds of smoke that issue from the chimney and which afterward settle as soot. After the volatile matter is all driven off, there still remains the fixed carbon, which now is in the form of coke. This gives but little flame and no smoke in burning, as the particles of carbon are not detached from the solid mass till combustion takes place.

The causes of smoke may, from the foregoing description, be stated to be either: (1) An insufficient amount of oxygen for the perfect combustion of these combustibles; or (2) an imperfect mixture or distribution of the oxygen with the combustibles, even though present in sufficient quantity; or (3) a temperature too low to ignite the distilled volatile matter and the separated free carbon when properly mixed with the air.

The loss of fuel in the smoke itself is not very serious, as a very dense black smoke represents but a small lot of carbon. The British Smoke Abatement Committee, in 1882, estimated the fuel lost in the densest smoke to be less than 1% of the coal producing it. In our own country, Mr. J. C. Hoadley, by experimentally passing very dense black smoke from bituminous coal through water and collecting the solid carbon, found that it only amounted to about 1-6 of 1% of the coal burned. The most serious losses are due to the escape of some of the light hydrocarbons and carbonic oxide—both invisible gases—the former of which has a calorific power nearly double that of pure carbon, and the latter about one-third that of pure carbon. While, therefore, the losses of fuel are not confined to the smoke itself, still the total losses may be assumed as generally being indicated by the amount of smoke produced, since the conditions that are unfavorable to the combustion of the free carbon, which appears as smoke, are also unfavorable to the combustion of the other combustible gases which tend to escape.

Touching the hygienic effects of smoke, Dr. W. A. Daley, a prominent physician of Pittsburg, stated before the Engineers' Society of Western Pennsylvania, in March, 1892, that every medical man in Pittsburg who had made post-mortem examinations recognized the effect of smoke in the darkly mottled lung-tissue filled with carbonaceous matter, and distinctly stated that this deposit induces consumption of an incurable character. He said that the death rate in that city during the eight years of freedom from smoke was 1.62 per 1,000 lower than for the preceding eight years of smoke, and that since the partial return of the smoke the death rate has again risen from 19.58 per 1,000 to 22.15 per 1,000, showing an increase of 2.57 per 1,000, notwithstanding the fact the period of low death rate included the fatal epidemic of "la grippe" in that city. The increase in Pittsburg's death rate placed it above those of St. Louis, Chicago, Buffalo, Detroit, Milwaukee, Louisville, Indianapolis and other cities whose hygienic conditions are otherwise not superior to those of Pittsburg. It is well known that carbon, either in the porous form of charcoal, or in the finely divided form as soot, has a very great capacity for the absorption of gases. It is equally well established that floating particles in the atmosphere draw to them the minute spores, organisms and impurities that are ever present in the air about a large city. It is not difficult to imagine, therefore, that the soot that inhabitants of a smoky atmosphere inhale with every breath, but do not exhale, may be the carrier of both noxious gases and organic impurities.

But the sanitary objection to smoke is not the only one. It is objectionable from the disagreeable defacement of public buildings and residences, by the insidious soot which pervades our dwellings, offices, libraries, picture galleries and stores, injuring our clothing, pictures, books, papers, furniture and bric-abrac. It is objectionable from the fruitless efforts for cleanliness where cleanliness is impossible. It is objectionable from the loss of light and the increased cost of artificial light. It is objectionable from the repression of aesthetic tendencies and the mental and moral depression and discouragement. It is objectionable in its effects on our citizens, many of the more wealthy and cultivated of whom will not remain in an atmosphere of smoke.

The Smoke Remedy.—In the ordinary boiler furnace as generally constructed and fired, the conditions are very unfavorable for perfect combustion during the period in which the volatile matter is being driven off from each charge of coal. When the fixed carbon stage is reached there is but little difficulty in maintaining perfect combustion, but when a fresh charge of coal is added the difficulties appear; the air supply, if not in excess during the burning of the previous incandescent coal will now be in deficit, since the distillation of the volatile matter calls for an increased amount of air, while in fact the greater depth of coal now on the grate actually reduces the supply. If an additional supply is admitted through the furnace doors it will be cold and cannot be thoroughly mixed with the combustible gases. So with the temperature; if high enough before charging, it is now much lower, owing to the cooling effects of the cold air rushing in when the doors are opened, of the mass of cold coal, of the evaporation of the moisture in the coal, and of the distillation of the volatile matter, so that by the time a high temperature is needed to burn the free carbon, the furnace is at its coldest.

In fulfilling the requirements of sufficiency of supply and thoroughness of mixing the air with the combustible gases, it must be noted that these conditions should not be secured by a reckless surplus of air; as this carries away useful heat which is not only a loss in itself, but may, and often does, result in lowering the temperature of the combustible gases below their temperature of ignition, thus causing the escape of unburned fuel. Owing to the difficulty of effecting such a thorough mixture as to bring to each combustible particle just its proper amount of air, it is necessary to provide a surplus of air, but this should be considered as an evil to be kept at a minimum by the most thorough mixing possible. Each pound of carbon requires for perfect combustion about 12 lbs. of air; and each per cent. of excess over this amount has the effect to not only reduce the total available heat by about ⅛ of 1%, but reduces the temperature of combustion by about ½ of 1%, with the unknown resulting loss of unburned escaped fuel mentioned above.

A very large proportion, probably over 90%, of all the smoke produced comes from steam boiler furnaces (including those of locomotives and steamboats) and from domestic fires. As to the relative proportion of the two classes, it is doubtful if the former produces as much smoke as the latter in the aggregate; but coming from sources less scattered and being concentrated in dense black clouds, the smoke from boilers is more noticeable, deposits a larger proportion of soot, and can be more readily reached and more effectively remedied than that from domestic fires. As the combustion in these two cases takes place under radically different surroundings it will be necessary to treat the subject of smoke prevention in these two cases under different heads.

Passing to the means of accomplishing combustion without smoke production, it is safe to say that, so far

*Extract from a report to the State Board of Health of Tennessee.

as pertains to steam boilers, the object must be attained by one or more of the following agencies:

1. By the proper design and setting of the boiler plant. This implies proper grate area; sufficient draft; the necessary air admission space between grate bars and through furnace, and ample combustion room under boilers.

2. By that system of firing that is best adapted to each particular furnace to secure the perfect combustion of bituminous coal. This may be either: (a) "Coke firing," or charging all coal into the front of the furnace until partially coked, then pushing back and spreading; or (b) "alternate side firing"; or (c) spreading," by which the coal is spread over the whole grate area in thin, uniform layers at each charging.

3. The admission of air through the furnace door, bridge wall or side walls.

4. Steam jets and other artificial means for thoroughly mixing the air and combustible gases.

5. Preventing the cooling of the furnace and boilers by the inrush of cold air when the furnace doors are opened for charging coal and handling the fire.

6. Establishing a gradation of the several steps of combustion so that the coal may be charged, dried and warmed at the coolest part of the furnace and then moved by successive steps to the hottest place, where the final combustion of the coked coal is completed, and compelling the distilled combustible gases to pass through this hottest part of the fire.

7. Preventing the cooling by radiation of the unburned combustible gases until perfect mixing and combustion have been accomplished.

8. Varying the supply of air to suit the periodic variation in demand.

9. The substitution of a continuous uniform feeding of coal instead of intermittent charging.

10. Down-draft burning or causing the air to enter above the grate and pass down through the coal, carrying the distilled products down to the high temperature plane at the bottom of the fire.

The number of smoke prevention devices which have been invented is legion. The scope of the present paper renders anything more than a brief classification of their principles of working impossible. These are:

(a) Mechanical stokers, which automatically deliver the fuel in a crushed or finely divided state into the furnace at a uniform rate, and also keep the fire clean by a slow but constant motion of the individual sections of the grate. They accomplish their object by means of agencies 5, 6 and 9 of the foregoing list. They effect a very material saving in the labor of firing and are efficient smoke preventers when not pushed above their capacity, and when the coal does not cake badly. They are rarely susceptible to the sudden changes in the rate of firing frequently demanded in service.

(b) Air flues in side walls, bridge wall and grate bars through which air when passing is heated. (Agency 3.) The results are always beneficial, but the flues are difficult to keep clean and in order.

(c) Coking arches, or spaces in front of the furnace arched over, in which the fresh coal is coked, both to prevent cooling of the distilled gases and to force them to pass through the hottest part of the furnace just beyond the arch. (Agencies 6 and 7.) The results are good for normal conditions, but ineffective when the fires are forced. The arches also are easily burned out and injured by working the fire.

(d) Dead-plates, or a portion of the grate next the furnace doors, reserved for warming and coking the coal before it is spread over the grate. (Agency 6.) These give good results when the furnace is not forced above its normal capacity. This embodies the method of "coke firing" mentioned before.

(e) Down-draft furnaces, or furnaces in which the air is supplied to the coal above the grate and the products of combustion are taken away from beneath the grate, thus causing a downward draft through the coal, carrying the distilled gases down to the highly heated incandescent coal at the bottom of the layer of coal on the grate. Agency 10. In this furnace the grate-bars must be kept cool by the circulation of water through them, as they have to bear the hottest portion of the flame. This is the most perfect manner of producing combustion and is absolutely smokeless.

(f) Steam jets to draw air in or inject air into the furnace above the grate, and also to mix the air and the combustible gases together. (Agency 4.) A very efficient smoke preventer, but one liable to be wasteful of fuel by inducing too rapid a draft.

(g) Baffle plates placed in the furnace above the fire to aid in mixing the combustible gases with the air. (Agency 4.)

(h) Double furnaces, of which there are two entirely different styles; the first of which places the second grate below the first grate; the coal is coked on the first grate, during which process the distilled gases are made to pass over the second grate, where they are ignited and burned; the coke from the first grate is dropped onto the second grate. Agencies 6 and 7. A very efficient and economical smoke preventer, but rather complicated to construct and maintain. In the second form, the products of combustion from the first furnace pass through the grate and fire of the second. Each furnace being charged with fresh fuel when needed, the latter generally with a smokeless coal or coke. An irrational and unpromising method.

Passing to the prevention of smoke from domestic fires, the fortunate circumstance is presented that the evil is decreasing, due (1) to the growing tendency to heat all public buildings and large residences by either steam, hot water or hot air, using furnaces, either of improved form or such as can be made smokeless by some of the foregoing agencies; (2) to the increasing use of base burners and improved forms of fire grates, the former of which are practically smokeless and the latter partially so. It will be proper to bring pressure to bear to suppress the smoke from domestic fires, when the more serious and more easily remedied boiler smoke has been abated.

Smoke prevention must be accomplished from the side of the public by educating the people to consider smoke as a nuisance that unquestionably can and should be abated. It is idle to attempt the prevention of smoke by appealing to the interests of the smoke producers, as it is always difficult to prove to their satisfaction the extent to which it is to their interest to prevent its production, and when so proven they are not always willing to give the increased attention and immediate expense to secure the small, continual, prospective savings in fuel. In many cases boilers are being forced much above their maximum proper capacity; in such cases smoking is almost inevitable, and can only be stopped by reducing them to their proper capacity, which means less steam per boiler and more boilers, the supplying of which and the alteration necessitated thereby may cost more than the capitalized amount of the prospective annual saving in fuel. The same may be true of boilers with very defective setting or draft. In all such cases the pressure must be brought from without, and with propriety, for the fact of the increased necessary expenses gives no smoke producer the moral or legal right to pollute the atmosphere and injure the property of thousands or even of one of his neighbors.

It is no longer a problem whether smoke can be prevented or not. This has been settled conclusively in the affirmative in a number of localities where proper laws for smoke abatement have been passed and enforced.

Manchester and Birmingham, in England, and Glasgow, in Scotland, under the action of the Smoke Abatement Act, have had their atmosphere very greatly improved. A prominent citizen of Pittsburg, formerly of Birmingham, says: "On my recent visit to Birmingham, England, I was surprised to see such a clear atmosphere and smokeless chimneys compared with the Birmingham I saw 21 years ago."

Another resident of Birmingham says:"Birmingham, a manufacturing town of half a million inhabitants, and using no fuel but bituminous coal, is comparatively clean." . . . . "The reasons that Birmingham is comparatively clean are doubtless the Smoke Consuming Act and the public spirit that sees that it is enforced."

Mr. C. F. White, Consulting Engineer to the Chicago Society for the Prevention of Smoke, writes under date of May 4, 1893:

> The experience had in Chicago has shown plainly that it is perfectly easy to equip steam boilers with furnaces which shall burn ordinary soft coal in such a manner that the making of smoke dense enough to obstruct the vision shall be confined to one or two intervals of perhaps a couple of minutes' duration in the ordinary day of 10 hours." . . . . "It is safe to say that the work of the past year has resulted in diminishing the amount of smoke in and about the business center of Chicago by 75% to 80% as a whole, and there are plenty of individual cases where the abatement will probably reach more than 98% of the smoke made a year ago.

In Cincinnati, where—like Chicago—a law had been on the statute books for a long time without results because not enforced, a supervising engineer has, within a year, been appointed, and has made substantial progress by securing convictions, under the smoke ordinance, in a large majority of the suits brought. There has also been a very decided abatement of smoke in a large number of cases notified to abate, and a still larger number are making the changes necessary to accomplish smoke abatement. From his experience of the past few months, the supervising engineer expresses the belief that "within the next three months 500 chimneys will be made smokeless."

These facts establish the possibility of smoke abatement in the cities mentioned, whose conditions are not more favorable for its accomplishment than in hundreds of other cities. Although the technical possibility of smoke abatement is no longer uncertain, there still remain three important steps to be taken before its benefits may be secured by any city. These are:

1. The education of the people to the objectionable effects of smoke and to the possibility of its abatement.

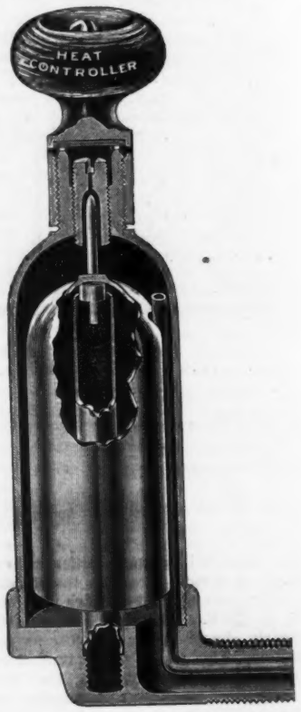
2. The enactment of suitable laws for the accomplishment of smoke abatement.

3. The provision for systematic enforcement of the above ordinances by continual inspection and legal prosecutions and for furnishing to smoke producers, when desired, professional advice and assistance regarding means and appliance for smoke prevention.

The best laws are fruitless without an intelligent public sentiment behind them that will not only support them but will see that they are enforced. Smoke producers should be encouraged in their efforts to comply with the laws by having the benefit of reliable and professional advice, when desired, to aid them in selecting the most effective and economical means and appliances for smoke prevention from the endless number of good, bad and indifferent inventions that follow in the wake of all smoke reforms, and which appear to the average purchaser to be of equal merit.

AN IMPROVED AIR VALVE FOR STEAM RADIATORS.

The accompanying cut shows in section an air valve for steam radiators, made by the Van Auken Steam Specialty Co., of Chicago, which contains several important improvements. In our issue of Aug. 24, 1889, we illustrated and described the principal types of automatic air valves which were then on the market. The duty of these air valves is to open a vent-hole by which the air may escape from the radiator when steam is turned on, and automatically close it as the steam fills the radiator and reaches the valve. The chief objection to the old styles of automatic air valve was that in case



An Imoroved Air-Valve For Steam Radiators.

the radiator become filled with water while shut off, through small leaks in the steam valve, this water would when steam was again turned on be forced out through the air valve; and it was necessary to lead a drip pipe from the air valve to some point where the water could discharge without injury.

In the valve illustrated a float is arranged to prevent the escape of water from the air valve. The operation will be evident on examination of the cut. A small cylinder of vulcanite incased in metal is screwed on the base of the valve and is connected to a needle plug. Thus when the vulcanite is heated by the steam, it expands and the needle closes the exit orifice for the air.

An additional feature of the device is a "heat controller," by which the escape of air from the register may be entirely shut off. It is claimed that in this manner a part of the radiator may be "air-bound," and only a portion of the radiating surface will be effective, thus giving a lower rate of radiation for mild weather. A small independent pipe extends from the interior of the radiator to a point near the exit orifice, thus giving duplicate outlets from the radiator. The float is made from one piece of metal, and there are no soldered joints in any part of the valve.

GERMAN PUBLIC WORKS.

In the "Reports from Consuls of the United States" for February, 1893, Mr. A. E. Washburn, U. S. Commercial Agent at Magdeburg, gives a number of tables relating to the public works in German municipalities, from official sources and for the year 1890. The first is the population of 47 German cities, and their increase in population in the period 1885-90. These cities range from 54,161, for Potsdam, to 1,578,794, for Berlin, and the average gain for the five years seems to be under 3%, though Augsburg figures at 11.57%.

The paving of 30 German cities comes next, with the total area of streets and character of paving in each. The streets of Berlin cover 6,357,040 sq. yds., and of this area 4,909,221 sq. yds. are paved with stone, 786,576 sq. yds. with asphalt and 82,404 sq. yds. with wood; the remainder is otherwise constructed. In the matter of asphalt pavement Magdeburg comes next, with about one-fourth as much as Berlin; but in the other cities neither asphalt or wood figures to any extent as paving materials.

The average cost of paving per square meter forms another table; but as the total area and total cost of pavement of all kinds are used as factors, the information given is not very satisfactory. The tables giving cost of street cleaning and sprinkling are open to the same objections, though some information may be gathered from them in connection with the other tables. Another long table gives the length of sewers, the number of buildings connected with them and their tenants, the cost of the sewerage systems up to 1890 and the cost of operating.

In the tables devoted to water-works, it appears that Berlin, with its 1,578,794 people, has only 21,038 houses connected with the distribution system, and has an annual pumping capacity of 51,100,000 cu. m. for a total annual consumption of 34,770,828 cu. m. Of this latter amount 30,290,971 cu. m. pays taxes, and the remainder is presumedly used for municipal purposes. The average daily consumption per head is 14.3 gallons (55 liters), and the total expenses of the department are 1,342,281 marks, against gross receipts of 6,263,026 marks. Tables showing the price of gas and petroleum lighting, number of jets and lamps and gas motors, close the list.

LEGAL DECISIONS OF INTEREST TO ENGINEERS.

Authority of Town Board with Regard to Assessment Commissioners.

Where a town board, acting upon a petition to widen and improve a street, appoints commissioners to assess damages and benefits, and rejects the report of such commissioners, the appointment of other commissioners for that purpose, without any new petition being filed, and an acceptance of their report, is not within the jurisdiction of the board. (Millizer v. Wagner, Supr. Ct. of Ind., 32 N. E. Rep., 927.)

Letting of Contract for Street Improvements.

Where a city charter provides that the notice required to be given of the letting of a contract for street improvements shall state the time when, and the place where, the contract will be let, and the time within which the work must be done, and requires the contract to be let to the lowest responsible bidder, a notice which states that bids will be received at the recorder's office until a date named, the work to be completed within a certain length of time from the letting of the contract, is sufficient, as at the date specified, the lowest bidder will be entitled to the contract. (Roach v. City of Eugene, Supr. Ct. of Ore., 31 Pac. Rep., 825.)

Dedication of Highways.

Marking a street on the plat of a town, or addition thereto, and selling lots with reference to such street, dedicates the ground so marked to the use of the public as a street; and the purchasers of lots have a right to have all streets marked on the plat by which they purchased, kept open. Where a town has been laid out, and one of the streets, as originally marked, used by the public for 45 years, mere non-user of a portion of such street, occasioned by being fenced in with abutting property for 40 years, will not estop the town from reclaiming such portion, or give title by adverse possession, nor will it amount to an abandonment by the public. (Wolfe v. Town of Sullivan, Supr. Ct. of Ind., 32 N. E. Rep., 1017.)

CONSTRUCTION NEWS.

RAILWAYS.

East of Chicago.—Existing Roads.

ALLIANCE & NORTHERN.—It is reported that this road will be exended from Phalanx, Trumbull Co., O., its present terminus, to Lake Erie, a distance of about 28 miles.

BALTIMORE & CUMBERLAND.—We are informed by Chauncey Ives, Ch. Engr., Hancock, Md., that the location of this road between Cumberland and Hagerstown is not completed, and consequently not ready for contractors. The work will be advertised in this paper.

BOSTON & MAINE.—Surveys have been made for the extension of the West Amesbury road to Amesbury village, Mass., five miles, to connect with the branch from Newburyport.

CLEVELAND, CINCINNATI, CHICAGO & ST. LOUIS.—It is reported that plans are being prepared for an extension from North Vernon, Ind., to Louisville, and for one from Cincinnati to Louisville, through Madison, Ind.

FLINT & PERE MARQUETTE.—The extension of this line from Monroe, Mich., to Toledo, O., is progressing slowly. The right of way has been purchased as far south as the Ohio state line, and engineers are now laying out the work for the construction gangs.

LONG ISLAND.—The Montauk R. R. Co. has been incorporated by Austin Corbin and others to build a road from Bridgehampton, on the Long Island road, easterly to Fort Pond Bay and thence to Culloden Point, in Suffolk Co., about 25 miles; capital stock, $500,000.

NEWFOUNDLAND.—The colony has entered into a contract with Robert B. Reid to build 250 miles of road from Exploits, to which point the railway is now being built across the island to the west coast, with a terminus at Point au Bosque, on the southwestern extremity. He is to receive $4,000,000 in 3½% debentures. Mr. Reid has further entered into a ten-years contract to operate all the government railways in the country, 475 miles, for which he is to receive an annual postal subsidy of $38,000 and a grant of 2,375,000 acres of land. On the completion of the road to the west coast, daily communication is to be made with Canada and the United States by fast steamers.

OHIO SOUTHERN.—About 20 miles have been graded from Springfield, O., north, and 5 miles of track laid on the extension from Springfield via Tremont City, St. Paris, Quincy and St. John's to Lima, O., 69 miles. McArthur Bros., of Chicago, have the contract for grading the entire line, and the Edge Moor Bridge Works have the contract for a steel viaduct 1,185 ft., long and 85 ft. high over the Miami River, at Quincy. The masonry for the viaduct is about one-third finished. The maximum grade on the extension is 0.5%, and the maximum curvature 2°. Sixty-pound steel rails are being used.

PENNSYLVANIA.—Jutte & Foley, Pittsburg, have been awarded the contract for the construction of the Roslyn branch of this road. The work is to be completed within three months.

PROVIDENCE & SPRINGFIELD.—The extension from Pascoag Station, the former terminus of this road in Burrtville Township, R. I., to a connection with the New York & New England R. R. in the town of Douglas, Mass., a distance of 6.84 miles, was completed on June 1, and will be opened for traffic by June 11. Of the total 6.84 miles, 5.21 miles are in Rhode Island and 1.63 miles in Massachusetts. The maximum grade is 52.8 ft. per mile on tangents with compensation at the rate of 0.05 ft. per 100 ft. per degree of curve. The maximum curve is 5°. There are two wrought trestles, one 333 ft. and one 330 ft., one wooden trestle 204 ft. long, and two through iron girders 41 ft. and 48 ft. long. The contractors for the iron bridgework were the Boston Bridge Works, and for the grading, masonry, tracklaying, etc., Ward Bros., Kennebunk, Me. Ch. Engr., L. B. Bidwell, Boston, Mass.

Projects and Surveys.

DAYTON JUNCTION TERMINAL & BELT LINE.—This line, which is building 17¼ miles of road at Dayton, O., proposes to construct a belt road for Springfield. A spur would then be built to the Clark Co. line to meet a similar spur from the Dayton belt line. There would be no grade crossings of principal streets and no passenger traffic unless by electricity. Pres., A. E. Boone; Ch. Engr., John B. Yates.

MUSKEGON TERMINAL.—Work on this road has been commenced at the mouth of Muskegon River. Pres., W. H. Dewees, Muskegon, Mich.; Ch. Engr., C. E. Gamble.

Southern.—Existing Roads.

ATLANTIC SHORT LINE.—Pres. John R. Young, of this railway, projected from Macon to Savannah, has issued a circular calling for a meeting of the stockholders for June 6. The object of the meeting is to hear the president's report, and take steps for the preservation of the company's property, as well as to take whatever action may be necessary to complete the road. This railroad is the old Macon & Atlantic, a portion of which, from Benton (Ga.) to Stillmore, has already been completed.

MANCHESTER & AUGUSTA.—Proposals are invited for the grading, trestle work and masonry upon the extension from Remini, in Clarendon Co., to Denmark, in Barnwell Co., a distance of 44 miles. Amount of material to be moved, about 1,500,000 cu. yds.; amount of trestle to be built, about 5¼ miles. The work will be divided into sections of about 5 miles each. Bids may be made for the sections separately or for the whole work. Bids for sections will include the trestles upon them, with the exception of those at Santee River, North Edisto, South Edisto and Half Way Swamp. The Santee River trestle will be about 14,000 lin. ft., North Edisto about 2,800 lin. ft., South Edisto about 5,000 lin. ft., and Half Way Swamp about 1,000 lin. ft. For the above mentioned trestles separate bids are invited, and for the Santee trestle two bids, one for full pile trestle, the other for frame trestle upon pile foundation. At Santee trestle three forces will be required to be put in operation, and maintained until the work is completed. Bids for trestles will include clearing of the right of way 130 ft. in width. Bids will be opened on June 17, 1893, and contracts awarded upon accepted proposals at the office of the Wilmington & Weldon R. R. Co., at Wilmington, N. C. Work to be pushed with all possible dispatch, and to be completed on or before the 1st day of January, 1894.

MOBILE & OHIO.—The new officers of this road have been instructed to acquire possession of the road from Montgomery, Ala., to Columbus, Miss., 160 miles long, which is partly completed, and to complete the same.

SOUTH ATLANTIC & OHIO.—The differences between this company and the Louisville & Nashville, with regard to the $80,000 tunnel which is being constructed by the roads, have been adjusted and work has been renewed on the tunnel. Both roads will soon be completed to the coalfields of Big Stone Gap, Wise Co., Va.

WINCHESTER & BEATTYVILLE.—This road has been constructed from Beattyville, Ky., to a junction with the Kentucky Union, seven miles, and will be extended through Crystal Park, in Beattyville, to the Avent coal mines, another mile.

Northwest.—Existing Roads.

BURLINGTON, CEDAR RAPIDS & NORTHERN.—It is reported that this road will soon be extended from Watertown, S. Dak., to Aberdeen, the citizens of Aberdeen to obtain the right of way and grade the road the entire distance.

CHICAGO, ROCK ISLAND & PACIFIC.—Surveys have been made for an extension of this road from Ruthven, Ia., to Jackson, Minn., a distance of 34 miles.

DULUTH, MESABI & NORTHERN.—St. Louis Co., Minn., has voted to issue bonds for $250,000 for this road.

IOLA & NORTHERN.—McIntosh Bros., of Milwaukee, have been awarded the contract for building the first section of this road, which is to connect the Green Bay, Winona & St. Paul with the Minneapolis, St. Paul & Sault Ste. Marie. Work has already been begun at Scandinavia, Waupaca Co., Wis., from which point the road will run in a northwesterly direction to Prentice, Wis.

JACKSONVILLE SOUTHEASTERN.—According to the Galesburg, Ill., "Register," L. S. Olmsted, Ch. Engr., reports that approaches and piers are being prepared for the bridge, which will be of steel and 710 ft. long. Surveyors will soon determine upon the line between Canton and Galesburg.

SUPERIOR, RED WING & SOUTHERN.—J. C. Price, Red Wing, Minn., a director of this road, is reported as saying that work will soon be commenced.

Projects and Surveys.

ASHLAND TERMINAL.—This company has been incorporated by J. W. Cochran, Thos. Barron and others, of Ashland, Wis., to build a road 18 miles in length in Ashland Co.; capital stock, $500,000.

CLAYTON & PEA RIDGE.—It is reported that the right of way has been secured for this road, to extend about ten miles from Clayton, Ill., and that construction will soon be commenced. T. J. Clark, Pea Ridge, is superintendent of the road.

MINNEAPOLIS, ST. PAUL & LAKE SUPERIOR.—This road, according to reports, will soon be built. It will extend to Duluth, 136 miles, as stated in our issue of May 25.

Southwest.—Existing Roads.

ATCHISON, TOPEKA & SANTA FE.—It is reported that a company is being organized to build an extension of this road from Panhandle, Tex., to White Oaks, N. Mex., passing through Canyon City and Escarbada, Tex., and Sumner, N. Mex., and to connect with the Carthage branch northeast from White Oaks.

AUSTIN & NORTHWESTERN.—It is reported that a proposition has been submitted to C. P. Huntington which will result in the building of this road between Burnet and Lampasas, Tex.

CHICAGO, ROCK ISLAND & PACIFIC.—The tracklayers are at work 32 miles south of Bowie, Tex., leaving a gap of about 36 miles between the present terminus and the stockyards in North Fort Worth.

GREENFIELD & NORTHERN.—It is reported that surveys have been made for extending this road south from Aurora, Mo., and that the line will pass through Galena and Harrison and Little Rock, Ark. An extension to Osceola, Mo., is being considered.

GULF, BEAUMONT & KANSAS CITY.—R. H. Downey & Bro., Houston, have been awarded a contract for 25 miles of this road, and construction will be commenced at Beaumont, Tex., at once.

SOUTHERN PACIFIC.—According to press reports the stockholders of this road will meet June 30 to authorize the issue of $4,000,000 of bonds for extensions and improvements. It is reported that the road will be extended to Marshall, Tex.

TEXAS MIDLAND.—The engineering corps is now at work between Cooper and Paris, Tex., and there is a possibility that the line will be extended to Little Rock, Ark.

Projects and Surveys.

GAINESVILLE, McALESTER & ST. LOUIS.—The surveyors of this road have reached Custer City, a distance of eight miles from Gainesville, Tex.

HEARNE & BRAZOS VALLEY.—D. C. Giddings, Harry Haynes and W. H. Wood, Brenham, Tex., have been appointed a committee to confer with the projectors of the extension of this road to Brenham. The company has been authorized to extend the road from Stone City to Independence, Washington Co., Tex., about 20 miles.

Rocky Mt. and Pacific.—Existing Roads.

ATCHISON, TOPEKA & SANTA FE.—It is reported the narrow gage branch of the Colorado Midland R. R. to Midland City, Colo., will be completed within 30 days, and to Cripple Creek in August. Contracts will be awarded within a few days for grading the unfinished portion.

BURRARD INLET & FRASER.—The engineers locating this line between Vancouver, B. C., and Sumas, Wash., are reported as encountering considerable difficulty in securing a suitable route east of Langley. The work of clearing the right of way will soon be commenced.

CANADIAN PACIFIC.—It is reported that surveys have been completed for an extension of this road into the Slocan district this summer. The line, as established, runs from Revelstoke to the arm of Arrow Lake, where transfer boats will be used, thence by the east shore of the lake to Nakusp and across to the head of Slocan Lake, following the eastern shore to New Denver.

SOUTHERN PACIFIC.—According to press reports this road will soon be extended into Riverside, Cal. The most favorable route is reported as being from Colton, through Riverside to Chino, thence to Pomona and Monrovia.

SPOKANE FALLS & NORTHERN.—The contractors for this road from Northport, Wash., to the Canadian line, 10 miles, will commence tracklaying at once, and it is thought that the work will be completed within a few weeks.—The Nelson & Fort Sheppard Ry., from the Canadian line to Nelson, B. C., 60 miles, has been definitely located for 10 miles from Nelson, and the contract for construction awarded to A. C. McLean. The work will commence at once. Porter Bros., San

Francisco, have the contract for ties, trestles, bridges and timber-work.

Projects and Surveys.

COLUMBIA RIVER & ASTORIA.—It is reported that this road will be constructed by the Union Pacific. It will extend from Astoria to Gobel, Ore., 60 miles. Pres., J. H. Smith, Portland.

FLORENCE & CRIPPLE CREEK.—Bids will be received at Florence, Colo., June 10 for the construction of this road, 34 miles in length.

LOS ANGELES, OWENS VALLEY & UTAH.—The contract for the construction of this road between Mojave and Independence, Cal., about 153 miles, has been awarded to F. E. Green, Los Angeles, as stated last week. The second survey for the line has been completed by Henry L. Ryan and his assistants, and it is reported that a route by El Paso summit will be selected. It is proposed to continue the survey to Salt Lake City. The road is to be built entirely with English capital.

MONTEREY & FRESNO.—The Fresno "Republican" reports that contracts have been awarded for building this entire road. The line is to be completed to Salinas by November, and to Hollister by next February.

SAN DIEGO, YUMA & PHOENIX.—Vice-Pres. Collins states that eight miles of the road has been surveyed from Phoenix, and that he expects to reach Yuma, Ariz., by June 20, so that contracts can be let by July 1. A preliminary survey has been completed to Yuma, 174 miles, by Fred. Knox, Ch. Engr. It is reported that the right of way for the 174 miles has been granted free.

STOCKTON & BAKERSFIELD.—A prospectus is being prepared for a road through the San Joaquin Valley between these places.

WASHINGTON SOUTHERN.—Bids were received May 30 for the 4.6 miles of this road, referred to last week, from Kilroy switch, near Shelton, Mason Co., Wash., along Goldsboro Creek to the main line of the road. C. M. Sheafe, Receiver, Seattle.

WHITE & COLUMBIA RIVER.—Incorporated in Washington to build a road from Buckley easterly, following the White and Greenwater rivers to a point on the Columbia River; $50,000; Chas. W. Joynt, D. S. Morris, S. H. Hart, Edward Collins.

Foreign.

MEXICAN.—It is reported that the construction of a road between Apizaco and Zacatecas will soon be commenced, the government having already granted a subsidy for the project.

GUATEMALA & PORT BARRIOS.—It is reported that a contract for the construction of a road from the city of Guatemala to Port Barrios, on the Atlantic coast, has been awarded, and that four miles of the road have already been constructed.

STREET RAILWAYS.

FITCHBURG, MASS.—The Fitchburg & Leominster St. Ry. Co. has been authorized to construct a double track trolley road in Westminster, Gardner, Lunenburg, Sterling, Lancaster and Clinton, and to increase its capital stock to $500,000.

NATICK, MASS.—The Natick Electric St. Ry. Co. has been authorized to extend its lines through the towns of Sherborn, Natick, Framingham, Ashland and Hopkinton; also to change its name to South Middlesex St. Ry. Co.

NEWTON, MASS.—The Newtonville & Watertown St. Ry. Co. has been incorporated to build a road about two miles long; $50,000; Treas., J. L. Richards.

NEWTON, MASS.—The Newton St. Ry. Co. has been authorized to extend its tracks to Needham, Wellesley, Weston, Lincoln, Lexington, Belmont and Brighton, and to increase its capital stock, not to exceed $25,000 per mile, to $365,000.

ROCKPORT, MASS.—The Rockport Electric St. Ry. Co. has been incorporated to build a road in this town; $50,000; Geo. R. Bradford, Loring Grimes, H. N. Woods, E. G. Abbott.

OLNEYVILLE, R. I.—The town council of Johnston has granted the Union R. R. Co. an exclusive franchise for 20 years.

BUFFALO, N. Y.—It is reported that the Buffalo Ry. Co. will be granted a franchise for an electric road to Kensington, and that a double track line will be built as soon as possible. The Kensington Electric Land Co., recently incorporated, is interested in the project; $375,000; Pres., H. C. Wadsworth.

HOOSICK FALLS, N. Y.—The trustees will meet June 8 to take action on applications for street railway franchises, which, it is reported, will be granted

BRIDGETON, N. J.—The South Jersey Traction Co. has been incorporated to construct and operate street railways; $400,000; G. Wood, R. W. Clay, Philadelphia, and W. H. Bacon, Bridgeton.

TRENTON, N. J.—It is reported that an electric belt line will be built which will encircle the city and suburbs. Ex-Mayor Magowan and Frank L. Maguire are interested.

CHESTER, PA.—The Peoples St. Ry. of Chester has been incorporated; $50,000; Pres., Jos. R. T. Coates.

CLEVELAND, O.—The Cleveland Electric Ry. Co. will spend $500,000 in equipment within the next four months. Of this $200,000 will be devoted to the enlargement of the old East Cleveland power station, the capacity of which is to be increased by 2,100 HP. Additional cars will be purchased and seven or eight miles of track relaid.

TOLEDO, O.—The franchise for an electric road between this city and Maumee, 11 miles, has been awarded to A. E. Lang, who agrees to have the road completed by Sept. 1 and to carry passengers the entire distance for three cents. The right of way into Maumee has been secured by T. P. Brown, a bidder for the franchise awarded to Mr. Lang. Mr. Brown is supposed to represent the Toledo Electric St. Ry. Co.

NOBLESVILLE, IND.—The Central Indiana Electric Ry. Co. has been organized with a capital stock of $4,500,000 to connect this city, Indianapolis, Anderson, Muncie, Elwood, Tipton, Kokomo, Frankfort, Peru, Logansport, Lafayette, Marion and Fort Wayne with electric street railway lines. The stockholders include Paul Pontus, Philadelphia; J. T. Baker, Lewisburg, Pa.; N. D. Pontus, and W. B. Keep, Chicago; and the Illinois Electric Ry. Co., Chicago, which has recently been granted a franchise in this city.

APPLETON, WIS.—Surveys have been made for the proposed electric line between this city and Menasha.

STEVENS POINT, WIS.—The franchise for an electric street railway granted to Geo. A. Whiting and others has been extended for one year. It is reported that work on the road will be commenced within a few weeks.

WAUSAU, WIS.—Messrs. Ross, Alexander Jones and Deenfield, who have secured the franchise to build an electric street railway in this city, work to begin June 1, have asked for an extension for a year from the city council on account of being unable to obtain the necessary funds to carry on the work just at present.

LOS ANGELES, CAL.—Theodore Summerland has been awarded a franchise for an electric road in East Los Angeles.

ELEVATED RAILWAYS.

CHICAGO, ILL.—The Metropolitan Elevated R. R. Co. has commenced condemnation proceedings to perfect the right of way for its northwest extension.

SIOUX CITY, IA.—The work of equipping this road to use the trolley has been resumed, and, it is reported, will be completed in 60 days. The question of a new power house has not yet been decided.

HIGHWAYS.

NEW YORK.—The town of White Plains has voted to expend $50,000 on highways.

OHIO.—The commissioners of Cuyahoga county will receive bids at the court house, Cleveland, until June 12, for paving three roads with macadam or brick. Jay F. Brown, Co. Engr.

BRIDGES.

CUMBERLAND, R. I.—The joint committee of Lincoln and Cumberland, appointed to consider plans for the construction of a bridge over the Blackstone River have decided to recommend an iron bridge, with a 30-ft. roadway, two 6-ft. sidewalks, and a concrete floor.

ALBANY, N. Y.—Bids will be received until June 13 for building a lift bridge over the Erie Canal, at Water St. Ed. Hannan, Supt. Pub. Wks.

ROCHESTER, N. Y.—An endeavor is being made to secure the construction of a new bridge over the Erie Canal at West Ave.

JERSEY CITY, N. J.—The Jersey City & Bergen R. R. Co. has offered to construct a new bridge over Cornelius Ave. at Montgomery St.

BALTIMORE, MD.—The new bridge to be constructed over Jones' Falls, on Maryland Ave., will be 350 ft. long and 66 ft. wide, with three trusses, dividing it into two 20-ft. roadways, and two 12-ft. sidewalks.

CLEVELAND, O.—Bids will be received until June 28 for constructing the substructure of the Brooklyn bridge, across Big Creek Valley in Brooklyn township. A. E. Akins, Secy. Brd. Co. Comrs.

DELAWARE, O.—A committee has been appointed to advertise for bids for a bridge over Central Ave. Span 222 ft., 24-ft. roadway, two 5-ft. sidewalks.

WATER-WORKS.

ANTRIM, N. H.—E. Gustine & Son, Keene, have been awarded the contract for works, at about $20,000. Water will be brought from Campbell Pond, two miles distant, and at an elevation of 200 ft.

MEREDITH, N. H.—The town has voted $40,000 for works and electric lights.

CHICOPEE, MASS.—The contract for a 55 × 60-ft. iron stand-pipe has been awarded to Long & Walsh, Holyoke.

FALL RIVER, MASS.—The city treasurer has been authorized to negotiate a loan of $35,000 for a new pumping engine and $40,000 for extensions.

GREAT BARRINGTON, MASS.—Bonds have been authorized for $20,000 for extensions.

LYNN, MASS.—The governor has signed the bill permitting the city to take the water of Saugus River for municipal purposes.

MILLBURY, MASS.—The town has voted not to purchase the franchise of the Millbury Water Co., but to contract for a supply for fire or other purposes. The vote was close, and there is talk of another meeting.

NEW BEDFORD, MASS.—Geo. S. Rice and G. E. Evans have been awarded a contract for plans for additional supply.

ONSET BAY, MASS.—J. K. Nye, Fairhaven, has sunk several wells as an experiment, and it is now proposed to sink others, erect a pumping station, and to lay mains to Waban Grove at Onset Center, where a stand-pipe would be erected, thence to lay pipes through Onset Bay and Point Indolence, on Long Neck, in East Wareham, across Swift's Narrows, and ultimately to Plymouth Park and the entire East Wareham shore territory. The Onset Water Co. was incorporated last year by Mr. Nye and others, to take water from Sturtevant Pond, but a satisfactory arrangement has not been made with the owner.

SALEM, MASS.—The city has been granted authority to take water from Norwood and Beaver ponds, in Beverly and Miles rivers, in Beverly and Wenham, for a supply for its own use and for the town of Beverly.

WALTHAM, MASS.—The aldermen have voted $20,000 for extensions.

BUFFALO, N. Y.—The department of public works will receive bids until June 17 for 100 tons of pig lead.

CHATHAM, N. Y.—The Chatham Water-Works Co. has contracted with Jno. R. Thompson, Amenia, for four steel windmills and pumps for its plant.

DOVER PLAINS, N. Y.—A company is being formed to secure a gravity supply, wrought iron pipe to be used to conduct mountain stream to reservoir, and cast iron pipe from reservoir to village. Jno. R. Thompson, Amenia, is one of the incorporators and will have the contract for putting in the plant.

FAIRPORT, N. Y.—Two plans have been submitted: To take a supply from Bushnell's Basin pond and pump to a reservoir, estimated cost, $67,000; and to drill wells, estimated cost, $37,000.

FRANKFORT, N. Y.—The Stanwix Engineering Co., Rome, has reported in favor of a gravity supply, estimated to cost $47,640, with 40 hydrants.

HILLBURN, N. Y.—W. C. Foster has been appointed engineer of the Mountain Spring Water Co., which proposes to supply this place, Suffern and vicinity.

MILFORD, N. Y.—Jos. Lowe, Kingston, has recommended that a supply be secured from Murray Creek. A reservoir would be built at an elevation of 228 ft.

NEWBURG, N. Y.—The taxpayers have voted to spend $65,000 in further improving the Washington Lake supply.

NEWTOWN, N. Y.—A franchise has been granted to the Citizens' Water Supply Co. Cord Meyer, Jr., John Meyer and Alexander Baxter are interested. A franchise was granted to P. J. Gleason and others some months ago, and residents of the south side of the town have also applied for a franchise, pipe laying, according to reports, having been already begun by them.

WASHINGTON, N. Y.—Steps are being taken to secure a supply.

WASSAIC, N. Y.—Works will be put in by Jno. R. Thompson, Amenia, and M. K. Lewis, of this place. The supply will be from a creek, through filter beds, pumped to reservoir by steel windmills.

BEECH HAVEN, N. J.—Uriah White, Asbury Park, is sinking an artesian well for a supply. Wm. L. Butler, Mayor.

DECKERTOWN, N. J.—C. H. Smith, Middletown, has recommended a gravity supply from a stream on the farm of Wm. DeWitt, three miles distant. A 5,000,000-gallon reservoir would be constructed; estimated cost, $35,000. It is reported that public sentiment is divided as to the way to establish a plant.

WILDWOOD BEACH, N. J.—It is reported that an artesian well is being sunk to secure a supply.

CLAYVILLE, PA.—Works are being discussed.

COCHRANTON, PA.—Bids are asked until June 10 for works. C. A. Miller, Burgess.

FAIRCHANCE, PA.—The Fairchance Water Co. has been incorporated to secure a supply; $10,000; Treas., D. W. McDonald.

GARDEAU, PA.—It is reported that works will be put in.

HANOVER, PA.—The Hanover Water Co. will probably build a new reservoir.

McSHERRYTOWN, PA.—Daniel O'Donnell, Columbia, has been awarded the contract for works, at about $12,000.

PHILADELPHIA, PA.—It is reported that a contract for two 30,000,000-gallon pumps has been awarded to the Holly Mfg. Co., Lockport, N. Y.

PINE GROVE, PA.—The following contracts for new works have been awarded: Jackson & Wooden Mfg. Co., Berwick, pipe, $11,657; Levering & Vandegrift, Philadelphia, pipe laying, $4,828, and reservoir, $1,146.

ROYERSFORD, PA.—It is reported that the Home Water Co. of this place and Spring City will spend $30,000 in improvements.

SOUTH BETHLEHEM, PA.—A new company is proposed, to secure a supply from Lehigh Mountain.

FREDERICK, MD.—The city has purchased land near the city limits upon which a 6,000,000-gallon storage reservoir will be built.

GREENCASTLE, MD.—Surveys for works are being made by A. B. Stoler.

MIDDLETOWN, MD.—The contract for works has been awarded to Owen Patterson, Baltimore.

SISTERSVILLE, W. VA.—Contract for works, with pumping system, will be let at once. Alexander Potter, New York, has been engaged to prepare plans and superintend construction.

QUINCY, FLA.—The legislature has authorized the city to issue bonds for works.

TITUSVILLE, FLA.—Works are being agitated.

GREENVILLE, MISS.—Bids are asked until Aug. 1 for works. J. M. Lee, Cy. Clk.

PERRY, GA.—E. J. Fuller is interested in proposed works.

HARRIMAN, TENN.—It is reported that bonds will be issued for works.

CYNTHIANA, KY.—Bids are asked until July 1 for a franchise for works, as stated in our advertising columns. L. S. Williams, Cy. Clk.

MORGANFIELD, KY.—Bids are asked until June 20 for works. J. M. Waggner, Clk. Bd.

CINCINNATI, O.—Plans have been prepared for increased storage capacity on Price Hill. It is estimated that a masonry reservoir would cost $150,000 or $238,000 for a capacity of 5,000,000 or 7,800,000 gallons, respectively, and that four tanks, 30 ft. in diameter, would cost $42,000 or $62,000 for capacity of 425,000 or 648,000 gallons, respectively. It is reported that the plans for four tanks of 684,000 gallons capacity have been recommended for acceptance.

DAYTON, O.—Bids are asked in another column for pumping engines.

NAPOLEON, O.—Bids are asked until June 20 for works. J. B. Strawn, Engr.

NORWOOD, O.—G. Bouscaren, Engr., has been authorized to advertise for bids for a steel stand-pipe, 40 × 60 ft.; estimated cost, $18,000.

SANDUSKY, O.—The committee has recommended that one or two new cribs be built around the present one, and that the influent pipes be improved.

WAPAKONETA, O.—The construction of works is again being discussed.

WINTON PLACE, O.—We are informed by E. F. Layman, Engr., that works are under consideration; estimated cost, $20,000.

CONNERSVILLE, IND.—Bids are asked until June 15 for 38,000 ft. of cast iron pipe, as stated in our advertising columns. John A. Cole, Engr., Chicago.

LEBANON, IND.—John W. Hill, Consult. Engr., Cincinnati, has been engaged to report on works.

NILES, MICH.—A committee has been appointed to secure a better system of works.

OWOSSO, MICH.—It is reported that the present supply is inadequate and that an additional reservoir will be built.

AUSTIN, ILL.—The town clerk of Cicero will receive bids until June 22 for works.

CHICAGO, ILL.—It is reported that extensions, to cost $331,000, will be built in the Pullman, Roseland and the Humboldt Park districts; that mains will be laid in Kedzie and Crawford Aves., in connection with the Lake View system, to cost $100,000, and that $231,000 will be expended in extending the 68th St. system.

DUQUOIN, ILL.—It is reported that negotiations are pending for works.

KEITHSBURG, ILL.—Bids are asked until June 23 in our advertising columns for works. Chas. F. Sturtevant, Consult. Engr.

HARLEM, ILL.—Geo. C. Morgan, Chicago, has been engaged to prepare plans and specifications for the distribution system of the new works. Water is pumped from an artesian well to a storage reservoir, thence to a stand-pipe. There will be nine miles of mains. Contract will be let in July.

HIGHLAND PARK, ILL.—W. S. Shields, Chicago, engineer for the new works, informs us that all bids received May 23 have been rejected, and that the work will be readvertised as soon as a supplementary appropriation is made.

RIVER FOREST, ILL.—The new works have been completed and accepted. Geo. C. Morgan, Chicago, was the engineer and contractor. Water is pumped from an artesian well to a Morgan stand-pipe, 12 × 60 ft. Cost, $76,000.

WAUKEGAN, ILL.—The council has voted to purchase at once a pump of about 750,000 gallons capacity, without asking for bids.

KENOSHA, WIS.—It is reported that the mayor is preparing plans by which the town can build and own works.

MILWAUKEE, WIS.—The mayor has signed an ordinance authorizing the issue of bonds for $125,000 for extensions and new works.

DULUTH, MINN.—The committee has reported in favor of issuing bonds for $800,000 for works to be owned by the city.

ST. PAUL, MINN.—The department of public works will receive bids until June 13 for pipe, water towers, etc.

ST. JOHN, KAN.—The question of works is being agitated.

ALLIANCE, NEB.—Bids are asked until June 21 for works. A. A. Richardson, Engr., Lincoln.

FREMONT, NEB.—Bids are asked until June 12 for a 15 × 105-ft. stand-pipe. J. W. Andrews, Cy. Engr.

GORDON, NEB.—Bids are asked until June 15 for a complete system. Robt. McCarty, Vil. Clk.

BUFFALO, WYO.—The city has voted to issue bonds for $40,000 for works, and work will be commenced at once.

WALKERVILLE, MONT.—The council has granted a franchise to the Butte City Water Co. The Moulton Water Co. supplies the city at present.

WHITE SULPHUR SPRINGS, MONT.—Jno. R. King is reported as considering a proposition to construct works.

KIRKWOOD, MO.—C. G. B. Drummond, St. Louis, has applied for an exclusive franchise for 50 years.

WEST PLAINS, MO.—Several meetings have been held and correspondence opened for works, it is reported. Bonds are proposed.

EASTMAN, TEX.—It is reported that works will be put in by the Eastman Water Co. Address W. H. Parin.

HOUSTON, TEX.—It is proposed to issue bonds for works to be owned by the city.

PORTLAND, TEX.—A dam is being built to secure a supply.

COLORADO SPRINGS, COLO.—The contract for about $25,000 worth of pipe for the proposed extension has been awarded to the Colorado Coal & Iron Co., Bessemer. There were 12 bidders.

PORTLAND, ORE.—The water committee has voted to sell $300,000 of water bonds July 1 and $200,000 Oct. 1.

LOS ANGELES, CAL.—The council has purchased land for the headworks for the system to be owned by the city.

SAN FRANCISCO, CAL.—Chas. Van Norden, Pres. South Yuba Water Co., of Placer Co., Auburn, has made a proposition to the city for a supply. A conduit 120 miles long would be required, and the estimated cost is $12,000,000. A proposition has also been made to the city of Sacramento by the same company.

NORTH OGDEN, UTAH.—The Mountain Water Flume Co. has been incorporated to control the water of the Mountain Water stream and its tributaries; $6,000; Pres., Nathaniel Montgomery; Treas., Chas. Storey.

COOKSHIRE, QUE.—The citizens have voted a loan of $30,000 for works.

MONTREAL, QUE.—Bids are asked until June 13 for 1,430 gross tons of cast iron pipe and 216 of special castings. A. Davis, Supt.

TORONTO, ONT.—It is reported that the city engineer favors building a brick tunnel, 2¼ miles long, from the pumping station to a point in the lake where the water is 70 ft. deep; estimated cost, $800,000.

ARTESIAN WELLS.

BUSHNELL, ILL.—Bids are asked until June 14 for ten 3-in. tubular wells, one 10-ft. well and one 4 × 8-ft. well, 120 ft. deep. O. C. Hicks, Cy. Clk.

COLLEGE STATION, TEX.—L. S. Ross desires bids for a well at Prairie View State Normal School; also for a stand-pipe at this place.

IRRIGATION.

SARATOGA, WYO.—It is reported that McDonald, Hallis and Bradford, Platte Valley ranchmen, are preparing to construct a ditch on Beaver Creek, near the Colorado line. The ditch will be 8 miles long, 18 ft. wide at top, 12 ft. wide at bottom, and 3½ ft. deep, with a grade of 2½ ft. to the mile. It is expected to irrigate 5,000 or 6,000 acres.

ELLENSBURG, WASH.—It is reported that a canal will be constructed to reclaim 40,000 acres in Kittitas Valley, for which surveys were made two years ago.

ONTARIO, ORE.—The Ontario Land & Irrigation Co. has been incorporated by David Wilson, Wm. Morfit, J. T. Clement and J. A. Lackey; capital stock, $100,000. A ditch is to be dug from the Snake River, down the west side of the river about 20 miles. It is proposed to use the water for power purposes, and to irrigate about 4,000 acres near the town. Ditches are being constructed within 20 miles of this place to irrigate 50,000 acres of land.

AZUSA, CAL.—Bonds for $80,000 have been voted for the improvement of the irrigation system.

SAN DIEGO, CAL.—A dispatch from this place states that the maps and plans of the Colorado Irrigation district show that water will be taken from the Colorado River, near Yuma, at an elevation of 200 ft. above the sea. Two main canals with numerous side canals are to be constructed, and 2,276,200 acres of desert brought under cultivation, of which 1,997,120 acres lie in San Diego Co., and 878,080 acres tributary to this county in Lower California.

NEW COMPANIES.—Butte County Irrigation & Land Co., San Francisco, Cal.; $1,000,000; Frederick Horner, D. P. Merrill, S. M. Holmes.—Santa Clara Valley Irrigation Co., San Jose, Cal.; $500,000.—Jumata Ditch Co., Whitewater, Colo.; $10,000.—Plunckett & Lynch Irrigation Co., Rapid City, S. Dak.; $25,000.

SEWERS.

PORTLAND, ME.—It is reported that important extensions are being planned, including a sewer in Commercial St., to cost $10,000.

FRANKLIN, N. H.—Surveys for a system are being made by F. L. Fuller, Boston.

BOSTON, MASS.—The metropolitan sewerage commission has opened the following bids for pumping plants, the first named price being for the plant at East Boston and the second at Deer Island: J. R. Freeman, Boston, $67,000, $67,500; Lynch & Woodward, Boston, $80,000, ———; Southwark Foundry & Machine Co., Philadelphia, $63,699, $64,250; Quintard Iron Works, New York, $73,750, $75,000; Holly Mfg. Co., Lockport, N. Y., $58,500, $59,500; Geo. F. Blake Mfg. Co., Boston, $89,612, $90,287; Henry R. Worthington, New York, $120,000, $122,000; Edward P. Allis Co., Milwaukee, $47,000, $47,000; Snow Steam Pump Works, Buffalo, $110,352, $112,500; Baldwinsville Centrifugal Pump Works, Syracuse, $53,850, $54,350.—The contracts for sections 30 and 44 of the main sewer have been awarded to Jones & Meehan, Jamaica Plain, at $53,589 and $33,330, respectively.

EVERETT, MASS.—The order authorizing a sewer loan of $125,000 has been passed by the aldermen.

HAVERHILL, MASS.—About 8,000 ft. of 12 to 8-in. pipe sewer will be built by the city. The superintendent of streets will purchase the pipe. J. F. Desmond, Cy. Engr.

LENOX, MASS.—At a meeting May 31 the town voted $25,000 for sewers.

SPRINGFIELD, MASS.—The sewer commissioners will receive bids until June 17 for sewers. J. W. Wilson, Clk. Bd.

BUFFALO, N. Y.—The department of public works will receive bids until June 17 for 24 to 10 in. tile sewers.

ELMIRA, N. Y.—The city clerk has been ordered to advertise for bids for certain sewers.

DUNKIRK, N. Y.—The city clerk will receive bids until June 20 for two sewers.

FORT PLAIN, N. Y.—The sewer commissioners will sell $20,000 of 4% bonds June 15.

NEW YORK, N. Y.—The commissioner of public works will receive bids until June 13 for 21 contracts.

NORWICH, N. Y.—Bids are asked until June 22 for about ten miles of 20 to 8-in. pipe sewers, for which bonds have been voted. W. M. Mason, Clk. Com.; C. P. Bassett, Engr. in Charge.

ROCHESTER, N. Y.—Plans have been completed for a sewer in wards 10, 15 and 20, and town of Gates.

SUFFERN, N. Y.—Jas. S. Haring has been engaged by the commissioners to design a system.

SYRACUSE, N. Y.—Plans have been prepared for additional sewers, including an outlet sewer, to cost $25,000.

TROY, N. Y.—The committee has recommended that several brick and pipe sewers be constructed.

ALLEGHENY, PA.—The common council is considering ordinances for ten lateral and five main sewers; also for the issue of sewer bonds for $300,000.

WILLIAMSPORT, PA.—Bids are asked until June 15 for about 6,500 ft. of pipe sewers, as stated in our advertising columns. H. C. Reeder, Cy. Engr.

BALTIMORE, MD.—Mendes Cohen, H. T. Douglas and F. H. Hambleton have been appointed by the mayor as a commission to report to the city council upon a general sewerage system.

WASHINGTON, D. C.—The following bids were received for a main intercepting sewer from Potomac River, near Easby's Point, to interception of Fifteenth and E streets: B. J. Coyle, Washington, $297,322; Sanford & Brooks, Baltimore, $281,367; National Construction Co., Boston, $238,962; H. L. Cranford, Washington, $206,227.—Congress has appropriated $90,000, and authorized the making of contracts in the sum of $250,000 for this purpose. The total cost of the work is estimated at $3,500,000.

COLUMBIA, S. C.—The question of a system is being discussed.

NASHVILLE, TENN.—The contract for the Lick Branch sewer has been awarded to Lesueur & Hutchinson, at $273,804. The use of convict labor or of convict-made materials is forbidden under a $50,000 bond and the forfeiture to the city of three times the value of all such labor or materials used. The total bids received were published in our issue of May 25.

ASHLAND, KY.—John W. Hill, Cincinnati, has been invited by the city council to visit the city and report on a system of sewerage and drainage.

CINCINNATI, O.—Plans have been prepared for a sewer in Badgely Run, which is intended to drain all of the Cumminsville district.

WARREN, O.—The citizens have voted 230 to 115 in favor of bonds for $20,000 for additional sewers.

WINTON PLACE, O.—E. F. Layman, Vil. Engr., informs us that plans are being prepared for a system.

MONTPELIER, IND.—Bids are asked until June 20 for a 48 to 32-in. brick sewer. D. F. Shannon, Town Clk.

SEYMOUR, IND.—A contract for about two miles of 24-in. tile sewer has been awarded to M. J. Bannard, Louisville, Ky., at $18,500.

GRAND RAPIDS, MICH.—A contract has been awarded to M. Tennis, at $27,500.

MARQUETTE, MICH.—The council has been authorized to borrow $36,000 for sewers.

NEGAUNEE, MICH.—Bids are asked until June 15 for sewers. C. R. Wightman, Cy. Engr.

OWOSSO, MICH.—The question of a system is being agitated.

BOONE, IA.—The city council has employed Col. Geo. E. Waring to prepared plans for a system.

FORT DODGE, IA.—Bids are asked in another column for sewers.

FARIBAULT, MINN.—Surveys have been completed, and it is reported that plans and specifications for a system will soon be submitted.

ST. PAUL, MINN.—The board of public works will receive bids until June 12 for several sewers.

ST. JOSEPH, MO.—The city engineer estimates that the proposed extension of the Mitchell Ave. sewer, 3,030 ft., will cost $51,850.

PALESTINE, TEX.—The time granted the water company for commencing work on a system of sewers has expired, and it is reported that another company may undertake the work.

DENVER, COLO.—The board of public works has approved plans and estimates for three sewers to cost $118,680, $117,200 and $101,472, respectively.

EVERETT, WASH.—The city council has instructed the city engineer to prepare surveys for a system.

MONTESANO, WASH.—It is reported that bids are being received for a system, construction to begin in July.

PETALUMA, CAL.—Surveys have been ordered made for a system in East Petaluma.

OTTAWA, ONT.—Several sewers will soon be constructed; estimated cost, $29,000.

STREETS.

HAVERHILL, MASS.—John T. Desmond, Cy. Engr., informs us that bids will be received until June 13 for 400,000 granite paving blocks, 7,000 lin. ft. curbing, and 1,000 ft. flagging. The city will pave about 10,000 sq. yds. with granite, but all street work is done by city by day labor.

BUFFALO, N. Y.—The Kensington Electric Land Co. has been incorporated, and will spend $25,000 in improvements; capital stock, $375,000; Pres., H. C. Wadsworth; Treas., C. L. Ingham.—The following bids have been received for paving: Bailey Ave., with asphalt, Barber Asphalt Paving Co., $44,417; German Rock Asphalt Co., $44,970; Upper Terrace, P. B. McNaughton, brick, $5,290; Medina sandstone, $7,994; Buffalo Paving Co., bituminous rock, $6,530; brick, $5,905; Barber Asphalt Paving Co., asphalt, $6,484; German Rock Asphalt Co., $6,712; Queen City Paving Co., brick, $5,781; stone, $8,425.

LONG ISLAND CITY, N. Y.—The general improvement commission, recently created, has authority to issue bonds for $1,000,000 for street improvements.

NEW ROCHELLE, N. Y.—The commissioners of highways will receive bids until June 19 for 30,000 to 35,000 sq. yds. telford paving, as stated in our advertising columns.

NEW YORK, N. Y.—The commissioner of public works will receive bids until June 13 for paving with granite and macadam.

SYRACUSE, N. Y.—Ordinances have been passed for paving several streets with asphalt, brick and Medina stone. For paving East Onondaga St. with asphalt the Syracuse Improvement Co. bid $23,217, and the Warren-Scharf Asphalt Paving Co., $25,044.

TONAWANDA, N. Y.—Bids are asked until June 15 for paving Delaware St. with brick; estimated cost, $80,000. Plans and estimates are being prepared for paving South Canal St. F. A. Ballard, Vil. Clk.

YONKERS, N. Y.—The council has ordered the paving of 12 streets; estimated cost, $304,600.

ATLANTIC CITY, N. J.—The council has voted to pave the streets in wards 1 and 4. It is reported that it will cost $300,000 to pave all the streets of the city.

ALLEGHENY, PA.—Contracts for paving have been awarded as follows: Joseph Hastings, granite blocks, 4 contracts, $139,343; Sloan & McIlwaine, Ligonier blocks, $27,000; Sicilian Asphalt Paving Co., Sicilian asphalt, 3 contracts, $29,561; H. C. Howard, asphalt blocks and granite between the tracks, $53,314. An ordinance has been passed authorizing the issue of street improvement bonds for $600,000.

CHARLEROI, PA.—An election will be held to vote on the issue of bonds for $42,500, divided as follows: Paving, $25,000; sewers, $10,000; water, $5,000; electric light, $2,500.

POTTSVILLE, PA.—The county commissioners will receive bids until June 24 for 2,147 sq. yds. grass sod, 607 sq. yds. white gravel, and 1,400 sq. yds. asphalt. A. B. Cochran & Sons, Engrs.

WILLIAMSPORT, PA.—The city clerk will receive bids until June 15 for paving three streets with brick.

WASHINGTON, D. C.—The following contracts have been awarded for laying composition blocks: Washington Asphalt Block & Tile Co., $7,000; Barber Asphalt Paving Co., $20,000; New York & Bermudez Co., $20,000.

CHARLESTON, S. C.—Bids are asked until July 20 for paving East Battery and South Bay streets with Trinidad Lake asphalt. T. A. Huguenin, Supt. Sts.

CINCINNATI, O.—Bids are asked by the board of administration until June 27 and 29 for paving with cobblestone and brick, respectively. The following bids were received for paving State Ave. with brick: D. Folz & Sons, $137,463; T. J. Peters, $142,970; E. Evans $137,528; Henkel & Sullivan, $133,647; F. H. Kirchnen, $133,172.

CRESTLINE, O.—Plans are being prepared for one-half mile of brick paving.

IRONTON, O.—Bids for paving two streets with brick ranged from about $31,000 to about $38,000.

LIMA, O.—R. H. Gamble, Cy. Engr., informs us that the bids received for 12,635 sq. yds. of brick paving have been rejected, the ordinance rescinded, and new proceedings commenced looking to the admission of bids on asphalt. The bids were as follows: Randolph Coleman, Springfield, $31,487 for 8 or 6-in. foundation; Marigold & O'Brien, Lima, $24,091 for 8-in., $26,618 for 6-in.; Standard Paving Co., Detroit, $21,953, $23,822.

MANSFIELD, O.—Bids are asked until July 1 for improving West Bloom St. F. M. Remy, Cy. Clk. The contract for paving Park Ave. with Jones' shale brick has been awarded to Herring & Straub, at $25,749.

TOLEDO, O.—Bids are asked until June 26 for paving three streets with Medina stone, cedar blocks, asphalt or brick. Sylvester Lamb, Cy. Clk.

COLDWATER, MICH.—It is reported that the principal streets will be paved.

YOUNGSTOWN, O.—The following bids have been received for paving Elm St.; all bids including a five-year guarantee, the pavement to be on a concrete base, and all but the first being for brick: Barber Asphalt Paving Co., asphalt, $30,342; Davis & Caldwell, brick, $21,350; F. E. Gribbon, $21,047; Con. O'Donnell, $19,491; Wilber Hersey, $20,000; Connell Bros., $19,024.

MONTPELIER, IND.—Bids are asked until June 20 for paving two streets with telford macadam. D. F. Shannon, Town Clk.

RICHMOND, IND.—The contract for paving 13 blocks in Main St. with Canton re-pressed brick has been awarded to the Standard Paving Co., Detroit, at $11.43 per lin. ft., including oolitic curbing.

DETROIT, MICH.—The following lowest bids have been received; Laidlaw Bros., paving St. Paul Ave. with cedar blocks on concrete, $19,107; M. L. McCarron, Baltimore Ave., cedar blocks on plank, $12,516. The contract for paving two sections of the Boulevard with limestone macadam has been awarded to the Michigan Stone & Supply Co., at $34,—, other bids being M. L. McCarron, $60,595; Henry Collins, $48,390; C. B. Parsons, $50,726.

GRAND RAPIDS, MICH.—Contracts for paving with Canton re-pressed brick and Metropolitan blocks have been awarded to Owen & Hayden, at $18,755 and $14,812, respectively; also with cedar blocks to L. Schneider, at $12,600. Additional paving is being considered.

IONIA, MICH.—It is reported that East Main St. will soon be paved.

ST. PAUL, MINN.—A contract for paving Third St. with cedar blocks has been awarded to Thatcher & Burk, at $29,000. The lowest bid on pine blocks was $33,000.

SAN FRANCISCO, CAL.—Marsden Manson and C. E. Grunsky, the engineers devising a system of sewerage, are reported as stating that there are 400 miles of streets in the city awaiting the establishment of grades, which should be done before sewers are constructed.

KINGSTON, ONT.—It is reported that Princess St. is to be graded and paved with brick.

ELECTRIC LIGHT AND POWER.

OLD ORCHARD, ME.—The Old Orchard Electric Light Co., recently organized, has been awarded a contract for 15 or more arc lights for ten years for street lighting, besides light for the camp ground and hotels. A plant will be put in for both arc and incandescent lighting. Pres., J. W. Duff.

YARMOUTH, ME.—A contract has been awarded to H. P. Loring for an incandescent lighting plant.

MEREDITH, N. H.—The town has voted $40,000 for electric lights and water-works.

DANVERS, MASS.—The town has appropriated $11,000 to increase the capacity of the municipal plant in order to do commercial lighting. Julius Peale, Town Clk.

HAMBURGH, N. Y.—The Hamburgh Water & Electric Light Co. desires bids for a plant for both arc and incandescent lights.

WILDWOOD, N. J.—It is reported that an electric light and railway plant will be put in at Wildwood Beach.

PITTSBURG, PA.—The city has voted to issue bonds for $100,000 for an extension of the light plant.

SANDUSKY, O.—Bids are asked until June 20 for a plant for 1,500 incandescent and 20 arc lights at the Soldiers' and Sailors' Home. D. Dugan, Q. M.

DOWAGIAC, MICH.—An election will be held June 13 to vote on the purchase of the plant of the local company, for $16,000.

PAW PAW, MICH.—Bids are asked for a lighting plant, including 50 arc lights of 2,000 c. p. and 500 incandescent lights of 18 c. p.

URBANA, ILL.—Bids are asked until June 15 for electric lights for seven years. C. B. Holmes, Cy. Clk.

SUPERIOR, WIS.—The St. Louis Water Power Co. has elected J. M. Butler president, and Jas. Bardon general manager. It is reported that propositions will soon be submitted to the cities at the head of the lakes to furnish electric power for factories and other use.

WINDOM, MINN.—The proposition to issue bonds for water-works and electric lights has been defeated, and it is now proposed to vote on the subject of lights alone.

HIGGINSVILLE, MO.—The city has voted to issue bonds for $17,000 for an electric light plant and for water-works.

GARFIELD, WASH.—The citizens have voted to issue bonds for $8,000 for an electric light plant.

WESTON, ORE.—Bids were received until June 7 for bonds for electric lights and water-works.

SALT LAKE CITY, UTAH.—The city council has passed an ordinance granting a franchise to B. M. Jones to transmit electricity into the city from Big Cottonwood Canon for public and private purposes.

NEW COMPANIES.—Lambertville Electric Light, Heat & Power Co., Lambertville, N. Y.; $50,000; L. H. Leber, Pittsburg, Pa.; C. Wiler, Jr., Lambertville.—Woodsock Electrict Co., Woodstock, Vt.; $22 000.—Norwich Light Co., Norwich, N. Y.; $50,000; E. F. Murray, Troy; S. C. Medbury, H. J. Donaldson Balston Spa.—Hillsboro Water, Light & Power Co., Hillsboro, Tex.; $50,000.—Knoxville Electric Light & Power Co., Knoxville, Ill.; $20,000; A. L. Warfel, C. F. Foote, W. H. Moorhouse.

CONTRACT PRICES.

ASPHALT BLOCK PAVING.—Baltimore, Md.—The only bid received for paving Lafayette Ave. with asphalt blocks was that of the Maryland Pavement Co., $2.50 per sq. yd. and $1.05 per lin. ft. for curbing.

BRICK AND MACADAM PAVING.—Kansas City, Mo.—Contracts have been awarded at the following prices: Paving with vitrified brick, $1.385 to $1.78 per sq. yd.; macadamizing, 67.9 cts. to $1.095 per sq. yd.

BRICK PAVING.—Ashland, O.—A contract for paving with brick has been awarded to Herring & Straub, Mansfield, the bid being as follows: Malvern brick, $1.12 per sq. yd.; Akron brick, $1.125; Canton brick, $1.14; new curbing, 34 cts. per lin. ft.; resetting old curbing, 5 cts. per lin. ft.

Lockport, N. Y.—The contract for paving Niagara St. has been awarded to Chas. Whitmore & Co., at $2.07 per sq. yd. for U. S. fireclay brick, the bid for other brick ranging from $2.09 to $2.18 per sq. yd.; total cost, about $28,000.

CEDAR BLOCKS.—Milwaukee, Wis.—Contracts for cedar paving blocks have been awarded at 60.5 to 62 cts. per sq. yd.

GRAVEL.—Minneapolis, Minn.—The contract for furnishing gravel for the ensuing year has been awarded to Kiesel & Lenan, at $1.40 per load delivered.

GRANITE BLOCKS AND CURBING.—Baltimore, Md.—Bids for furnishing the city with Belgian blocks for paving ranged from $60 to $68.50 per M., and for 6-in. granite curbing from 87.5 cts. to $1.15 per lin. ft.

CEMENT.—Washington, D. C.—Bids have been opened by the district commissioners for cement. The prices for natural cement ranged from $1.05 to $1.15 per bbl., and for Portland cement, ranged from $2.30 to $2.47.

DRAIN PIPE AND BRICK.—Lowell, Mass.—The contract for drain pipe has been awarded to Edward Cawley, at 76% off list price, and that for brick to C. J. Cheney, at $7.25 per M.

PIPELAYING.—Gloversville, N. Y.—The contract for laying about 8,500 lin. ft. of water pipe has been awarded to S. C. Ferguson, at 24 cts. per lin. ft. for 4-in. pipe, 26 cts. for 6-in., and 30 cts. for 10-in. Frank E. Dwyer bid 25, 27 and 31 cts., and Mullarkey & Senior, 27, 27 and 35 cts., respectively.

MISCELLANEOUS.

GARBAGE CREMATORS.—San Antonio, Tex.—The council has appropriated $13,000 for two garbage cremators.

LUMBER.—Winnipeg, Man.—Bids are asked until June 22 for 400,000 to 1,000,000 ft. B. M. pine lumber, G. H. West, Chn. Com. on Wks.

COURT HOUSE.—Cumberland, Md.—The commissioners of Allegany County will receive bids until June 24 for a county court house, as stated in our advertising columns.

FIRE HOSE.—Baltimore, Md.—The fire commissioners will receive bids until June 16 for 8,000 ft. 2½-in. fabric fire hose and 1,000 ft. 2½-in. hose with standard couplings.

FIREBOAT, ETC.—Cleveland, O.—The fire department has been authorized to issue bonds for $247,000, and it is reported that bids will soon be asked for a fireboat, three fire engines and other supplies.

CEMENT.—Brookline, Mass.—Bids will be received until June 12 for 2,800 bbls. American and 1,800 bbls. Portland cement for the Village Brook Channel, noted last week. A. H. French, Engr. The contract for the channel has been awarded to F. A. Snow, at $41,325, other bids being O'Connor & White, $47,203; Harry Nawn, $50,209; James Killian, $66,607.

DAM.—Minneapolis, Minn.—The commissioners of Hennepin county have ordered the city engineer to prepare plans and specifications for a new dam across the creek at Minnetonka.

Fairhaven, Vt.—J. R. Langdon is interested in a stone dam to be built across the Poultney River at Carver's Falls, with a power station to furnish 2,000 HP.

CITY HALL.—Jersey City, N. J.—The revised plans for the new city hall have been accepted and the commissioners will advertise for bids for the construction; estimated cost, $375,000.

Milwaukee, Wis.—The following total bids have been received for the city hall: Agnew & Co., Chicago, $683,000; Paul Riesen, $606,248; J. G. Jones, $698,000; Arthur Johnson & Bro., $699,000; Chas. B. Roberts, $717,000; Schienstedt & Kieckhefer, $749,00; Thomas R. Bentley, $780,000.

CRIB BULKHEAD, ETC.—New York, N. Y.—The department of docks will receive bids until June 20 for 3,000,000 cu. ft. cribwork at Riker's Island; 263 fender piles, 45 ft. long; labor for 4,172 lin. ft. crib bulkhead; 155,000 cu. yds. riprap; labor for 4,172 lin. ft. riprap embankment; 1,597,585 ft. B. M. yellow pine timber.

SPILLWAY, ETC.—Albany, N. Y.—Bids are asked until June 13 for constructing a spillway (overfalls and paved waste), at Eaton Brook reservoir; new stairs and new valves, Eaton Brook reservoir; rebuilding spillway at Bradley Brook reservoir, rebuilding bridge at Kingsley Brook reservoir, and building guard rail to highway on south side of Bradley Brook reservoir. Edward Hannan, Supt. Pub. Wks.

CANAL IMPROVEMENTS.—Albany, N. Y.—The state canal board has adopted plans and estimates for improvements to the state waterways. The work includes lengthening the lock on the Erie Canal near Crescent, for which $36,000 will be expended; rebuilding parts of the Schoharie aqueduct, at Fort Hunter; the upper Mohawk aqueduct, at Niskayuna; and the lower Mohawk aqueduct, at Crescent, for all of which $65,000 will be expended. The board also instructed the state engineer to prepare estimates and plans for 12 other pieces of work, including the Albany basin dredging, the rebuilding of the state dam at Cohoes, and the rebuilding of the dam at Little Falls.

INDUSTRIAL NOTES.

LOCOMOTIVES.—The Baldwin Locomotive Works, Philadelphia, Pa., have delivered 30 out of an order for 100 locomotives for the Baltimore & Ohio.

The Brooks Locomotive Works, Dunkirk, N. Y., have built five fast passenger eight-wheel engines for the Lake Shore & Michigan Southern.

The Gulf, Beaumont & Kansas City will purchase two engines. Gen. Man., John H. Kirby, Houston, Tex.

The Strong Locomotive Co., Cincinnati, O., has been dissolved. It was organized in 1890 with a capital stock of $1,000,000, but only a small amount was subscribed or paid in.

CARS.—The Gilbert Car Mfg. Co., Troy, N. Y., is completing an order for the New York Central for 50 passenger cars (54 ft. bodies), 20 smoking cars, 10 combination cars (60 ft. bodies), and 20 vestibuled cars (60 ft. bodies). The last 30 of these are on six-wheel trucks. The cars are elaborately finished, and one of them forms a part of the railway company's exhibit at the World's Columbian Exposition.

The Missouri Car & Foundry Co., St. Louis, Mo., has built 500 box cars, 34 ft. long, 60,000 lbs. capacity, for the St. Louis Southwestern.

The Wason Car Co., Springfield, Mass., has an order for 50 cars for the Manhattan elevated road, New York.

The United States Car Co., Anniston, Ala., has an order for 1,200 cars for the Louisville & Nashville.

The American Car Co., Basic City, Va., has an order for 300 freight cars for the Chesapeake & Ohio.

The Gulf, Beaumont & Texas will purchase 100 freight cars, 2 passenger cars, 1 mail car and 1 baggage car. Gen. Man., John H. Kirby, Houston, Tex.

THE HARVEY STEEL CAR & REPAIR WORKS, of Harvey, Ill., have been awarded a contract by the Thacher Car & Construction Co., of Chicago, for building two cast iron hopper cars for handling slag. One of these cars will be on exhibition at the World's Columbian Exposition, and the other will go into service. Mr. J. D. McIlwain, Genl. Supt., informs us that they have recently started a repair department for repairing passenger cars, in addition to their already extensive plants for repairing all kinds of wooden freight cars. The company has at the World's Columbian Exposition three steel cars on exhibit, consisting of one tank car (without the tank), illustrated and described in another column, one gondola coal car, and one box freight car. The frames of these cars are entirely of steel, composed principally of sections, and shapes that are standards and manufactured by most of the steel mills in the country. The exhibit is located in Section O, S., Posts 4 to 8, in the Railway Department of the Transportation Building.

CONDENSERS.—The battleship "Massachusetts," which is to be launched at the Cramps' works, at Philadelphia, on Saturday, has an outfit of Wheeler surface condensers for the auxiliary machinery. The condensers were furnished by the Wheeler Condenser & Engineering Co., New York.

METERS.—The National Meter Co., of New York city, has on exhibition at the World's Columbian Exposition, a complete line of its four styles of meters, ranging from ⅝ to 10 ins. in diameter. A line of meters ranging in size from ⅝ to 6 ins., inclusive, is in operation, all running with the same ⅝-in. stream. The exhibit is in the Manufactures Building, main floor, Section Q, Block 1. Pres., John Kelley.

GAS ENGINES.—The Nash gas engine, manufactured by the National Meter Co., New York city, is now made to drive pumps, ranging in capacity from 200 to 12,000 gallons per hour, or from 4,800 to 288,000 gallons per day, pumping to a height of 50 ft. Pres., John Kelley.

THE EUREKA SLACK ADJUSTER, or Higham device, for hand adjustment of slack of the brake gear, is now manufactured by the Q. & C. Co., Chicago and New York, which is also putting on the market the new Q & C automatic brake slack adjuster.

WELL PUMPS.—The improved Davidson artesian well pump is said to be meeting with success. Its construction is a radical departure in some ways from other forms of artesian well pumps, a distinctive feature being the location of the steam cylinder or engine which is secured adjacent to the well in a horizontal position on a suitable foundation, instead of being placed vertically over the well, as is the usual practice. This permits of the removal of working-barrel, bucket, pump rod, etc., without moving the steam cylinder or any part of same from its foundation; neither is it necessary to disconnect the steam or exhaust pipes to get at working parts in the well. Another feature is the absence of buffer or spring beams, as used in connection with the vertical well pump, a uniform and steady piston movement being secured, however deep the well, by the manipulation and arrangement of steam valve. The bucket in working barrel and the upper plunger are actuated by the movements of the steam piston, through a working beam overhanging the well. Water is discharged by the bucket on the up-stroke and by the plunger on the down-stroke. The area of the horizontal section of plunger is one-half that of the bucket, insuring an even and steady delivery. The steam valve motion is adjustable from the outside for any depth of well, and can be adjusted while the engine is running. M. T. Davidson, Brooklyn, N. Y., manufacturer, has recently placed several of these pumps in prominent establishments, including one steam cylinder 7 × 18 in., in the Weldon Building, Jersey City, N. J., one 10 × 24 in. in the Polar Construction Co.'s ice plant, at Newark, N. J., and another of the same size in Halcyon Hall, Millbrook, N. Y., all of which are said to be giving very satisfactory service.

JOS. R. ELLICOTT has opened an office for a general railway supply business at 115 Broadway, New York. He has resigned his position as general agent of the New York Car Wheel Works, of Buffalo.

AMERICAN RAILWAY EQUIPMENT CO.—The Chicago office has been removed from the Rookery to the Monadnock Building, and placed under the management of Mr. David Servis, inventor of the Servis tieplate. The company has secured all rights to the Servis tieguard (Eng. News, Feb. 9, 1893), the Servis brace-head spike, Servis nutlock and other recent inventions of Mr. Servis, and is said to be rapidly introducing them on leading railways.

THE D'ESTE & SEELEY CO., of Boston, makers of the Curtis steam traps and appliances necessary for steam users, report that after a two-months competitive test they have received an order from the McGahan Sugar Refinery, of Philadelphia, for 40 No. 2 traps, each trap to be supplied with a glass water gage and automatic air valve. The company is willing to place its appliances in competitive tests.

THE STEARNS MFG. CO., Erie, Pa., through its Chicago office, D. J. Lewis, Jr., Mech. Engr., has been awarded a contract for furnishing the Princeton (Ind.) water-works with the boilers, stack, fittings, etc. Geo. W. Sturtevant, Chicago, is the engineer.

THE BLOOMSBURG CAR CO., of Bloomsburg, N. J., has on exhibition at the World's Columbian Exposition a gondola car equipped with the "beamless brake" and a steam shovel rotary dump car.

NEW COMPANIES.—Elston Construction Co., Chicago, Ill.; $100,000; F. H. Watriss, Jacob B. Breese and W. R. Odell. Northwestern Construction Co., Chicago, Ill.; $50,000; Charles S. John and Frederick Donaldson. Self-Acting Air Brake & Car Coupler Co., Chicago, Ill.; $1,000,000; V. T. Keerner, T. D. Harley and Louis A. Roy. Minneapolis Air Brake Co., Minneapolis, Minn.; $500,000. Niagara Falls Tower Co., Niagara Falls, N. Y.; John W. Bunker, R. W. Jones and F. C. M. Lautz.